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The Engineer

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PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

SCHEDULE 1.—MALLEABLE IRON COUPLINGS for VACUUM BRAKE HOSE PIPES.
SCHEDULE 2.—STEEL TYRES for LOCOMOTIVES.
SCHEDULE 3.—STEEL BOILER TUBES for LOCOMOTIVES.
SCHEDULE 4.—COPPER FIRE-BOX PLATES for LOCOMOTIVES.
SCHEDULE 5.—FOUR 65-TONS STEAM BREAK DOWN CRANES.

Tenders due on the 14th August, 1928, for Nos. 1, 2, 3, and 4; and on the 28th August, 1928, for No. 5. Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each Schedule. 9204

Assistant Civil Engineers REQUIRED on the permanent pensionable establishment of the Works and Buildings Directorate, Air Ministry. Candidates must be between the ages of twenty-five and thirty years on the 22nd August, 1928; those who have served or are serving in the Army, Navy or Air Force may deduct from their actual age any time, not exceeding five years, during which they have so served. A candidate must be one of the following :—

(i.) A Corporate Member of either the Institution of Civil Engineers, the Royal Institute of British Architects, or the Institution of Municipal and County Engineers;

(ii.) A person qualified to become a Corporate Member of the Institution of Civil Engineers on attaining the prescribed age;

(iii.) A holder of a Degree in Engineering or an equivalent Diploma;

(iv.) A person who has held a commission in the Royal Engineers or an appointment in civil engineering under the British or Indian Government or a Dominion or Colonial Government and has been precluded by such employment from obtaining any of the above qualifications.

He must also have served for two years in an engineering firm of good standing or on the engineering staff of a Government or large municipal department or in the Royal Engineers and have there gained experience in civil engineering both in the drawing-office and on important engineering works. Special consideration will be given to candidates who served in H.M. Forces during the war.

The scale of salary for Assistant Civil Engineers is £250 with annual increments of £15 until the maximum of £450 per annum is reached, plus Civil Service bonus. The commencing salary will be £250 per annum plus Civil Service bonus, which at the current rate amounts to £111 2s. per annum. Successful candidates will be eligible for promotion to the grades of Civil Engineer and Superintending Civil Engineer.

No candidate will be appointed who fails to pass a strict medical examination as to his physical fitness for service at home and abroad.

Successful candidates will serve on probation for two years and their appointments will not be confirmed unless and until they have passed such probation to the satisfaction of the Air Ministry.

Copies of regulations and forms of application can be obtained from the SECRETARY (S.2), Air Ministry, Adastral House, Kingsway, London, W.C. 2; the forms should be returned completed so as to reach that office not later than the 22nd August, 1928.

Candidates must bear any expenses which they may incur in attending for interview. 9205

Assistant Civil Engineer (Grade I) REQUIRED by the Electrical Department of the GOVERNMENT of CEYLON for three years' service in the first instance. Salary, £500, rising to £960 a year, by annual increments of £46. Free passages are provided, and in the case of married men for wife and children also, not exceeding four persons besides the person selected. A rent allowance is paid if no quarters are available. Candidates, aged 22 to 35 years, must be Corporate Members of the Institution of Civil Engineers, or hold an Engineering degree or diploma recognised as granting exemptions from sections A and B of the A.M.I.C.E. examination. They must be good draughtsmen and capable of designing and carrying out buildings, bridges and other engineering structures, preparing detailed plans, taking out quantities and estimating. They must also have had experience in Surveying and Levelling.—Apply at once by letter, stating age, qualifications and particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/320. 9212

Assistant Engineers (5) REQUIRED by the GOVERNMENT of the GOLD COAST for a tour of 12 to 18 months' service, with possible extension. Salary £480 a year for three years, then £510, rising to £920 a year by annual increments. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 25 to 35, must be Corporate Members of the Institution of Civil Engineers or hold an Engineering Degree or Diploma recognised as granting exemption from Sections "A" and "B" of the A.M.I.C.E. examinations or must hold the Testamur of the Institution of Municipal and County Engineers. Must be capable of taking complete charge of construction of buildings, bridges and roads and have a thorough knowledge of surveying, quantities and measuring up of work.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/628. 9176

Applications are Invited by the Government of Bihar and Orissa for the APPOINTMENT of a DRAINAGE ENGINEER, PUBLIC HEALTH DEPARTMENT (Engineering Branch),

to prepare drainage scheme in Patna City.

One year in the first instance with possibility of extension.

Age 30 to 40 years.

Thorough experience of design and execution of works of modern main drainage and sewage purification. Pay in accordance with age scale, rising from Rupees 725 a month at age 30 to Rs. 1175 at age 40, plus, for officers of non-Asiatic domicile, overseas pay £25 a month at age 30 to 33 years and at £30 a month thereafter.

Provident Fund. Free first-class passage to India and back.

Strict medical examination.

Further particulars and forms of application may be obtained upon request by postcard to the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 25th August, 1928. 9210

PUBLIC NOTICES

University of Birmingham.
FACULTY OF SCIENCE.
ENGINEERING DEPARTMENTS.
I.—MECHANICAL ENGINEERING.
"CHANCE" PROFESSOR: F. W. BURSTALL, M.Sc., M.A. (Cantab.), M.I. Mech. E.
II.—CIVIL ENGINEERING (AND TOWN PLANNING).
"BEALE" PROFESSOR: CYRIL BATHO, M.Sc., D.Sc. (McGill), B.Eng., A.M. Inst. C.E.
III.—ELECTRICAL ENGINEERING.
PROFESSOR: WM. CRAMP, D.Sc., M.I.E.E.
THE FULL COURSES EXTEND OVER FOUR YEARS, and Students who enter after Matriculation and pass successfully the examinations at the end of each year will be ENTITLED TO THE DEGREE OF BACHELOR OF SCIENCE IN ENGINEERING.
THE SESSION 1928-29 COMMENCES ON OCTOBER 1st, 1928.
For detailed syllabus of the Faculty with full particulars of University Regulations, Lecture and Laboratory Courses, Fees, &c., apply to the REGISTRAR. 9146

North-Western Polytechnic.
PRINCE OF WALES-ROAD, LONDON, N.W. 5.
APPOINTMENT OF PRINCIPAL.
The North-Western Polytechnic is at present being erected, and the GOVERNORS will REQUIRE not earlier than January, 1929, the SERVICES of a PRINCIPAL. The candidate selected will be asked to act in an advisory capacity as from October, 1928.
The activities will comprise (i.) junior technical school of light engineering trades, (ii.) printing trades, (iii.) cabinet making and allied trades, (iv.) girls' trade school, (v.) day and evening classes for women, (vi.) a commercial department, and (vii.) social activities.
Candidates must be under 50 years of age and should possess a University Degree or its equivalent; they should have had experience in teaching technological subjects and also in administrative work.
Salary £1000 per annum. The question of increments and maximum salary to be considered later. The appointment will be subject to the terms of the Teachers' (Superannuation) Acts, 1918 to 1925.
Memorandum of conditions of appointment and form of application may be obtained by sending a stamped addressed foolscap envelope to the CLERK TO THE GOVERNORS, North-Western Polytechnic, 3, Temple Gardens, Temple, E.C. 4. 9185

PUBLIC NOTICES

Bradford Education Committee.
TECHNICAL COLLEGE.
FULL-TIME DAY COURSES are arranged to meet the needs of Students wishing to present themselves for the DEGREE EXAMINATIONS of the LONDON UNIVERSITY in

MECHANICAL ENGINEERING,
CIVIL ENGINEERING,
ELECTRICAL ENGINEERING.

Further particulars and prospectuses may be obtained on application to the PRINCIPAL, Technical College, Bradford. 9156

County Borough of Croydon.
EDUCATION COMMITTEE.
REQUIRED, for SEPTEMBER, TEACHER of PRACTICAL MATHEMATICS in First-year Mechanical Engineering Course, for one evening per week. Salary 15s. per evening of two hours.
Applications, with particulars of practical and teaching experience, to be sent to the Principal, Central Polytechnic, Scarbrook-road, Croydon.
R. B. MORGAN, Education Officer.
Education Office, Croydon. 9172

Bengal-Nagpur Railway Company, Limited.
The Directors are prepared to receive TENDERS for :—
930 AXLE-BOXES AND FITTINGS.
Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 1st August, 1928.
A fee of 10s. will be charged for each copy of the specification, which is NOT returnable.
Tenders must be submitted not later than Noon on Monday, 13th August, 1928.
The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.
By Order of the Board,
R. C. VOLKERS,
9189 Secretary.

PUBLIC NOTICES

Bengal-Nagpur Railway Company, Limited.
The Directors are prepared to receive TENDERS for :—
A. 672½ TONS M.S. FLATS.
39½ TONS M.S. TEES.
33 TONS M.S. ANGLES.
B. APPROXIMATELY 295 TONS STEEL RIVETS.
Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 30th July, 1928.
A fee of 20s. will be charged for each copy of Specification A, and of 10s. for each copy of Specification B, which is NOT returnable.
Tenders must be submitted not later than Noon on Wednesday, 8th August, 1928.
The Directors do not bind themselves to accept the lowest or any Tenders, and reserve to themselves the right of reducing or dividing the orders.
By Order of the Board,
R. C. VOLKERS,
9164 Secretary.

Borough of Swindon.
ELECTRICITY DEPARTMENT.
The Corporation of Swindon invite TENDERS for the SUPPLY, DELIVERY and ERECTION of :—
(1) ONE STORAGE BATTERY.
(2) THREE TURBINE-DRIVEN BOILER FEED PUMPS.
Specifications, forms of Tender and drawings may be obtained from Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W. 1, on payment of a deposit of £2 2s. for each Section, which will be refunded on receipt of a bona fide Tender within the prescribed time. The charge for extra copies of the specifications will be 10s. 6d. each.
Sealed Tenders, endorsed "Tender for Storage Battery" or "Tender for Boiler Feed Pumps," as the case may be, must be delivered to me at my office not later than 10 a.m. on Saturday, the 18th August, 1928.
The lowest or any Tender will not necessarily be accepted, and the Corporation will not consider any Tender which is not in accordance with the specification.
W. H. BENTLEY, Town Clerk.
Town Hall, Swindon, 31st July, 1928. 9178

The Madras and Southern Mahratta Railway Company, Limited, invite TENDERS for :—
(1) 9250 STEEL BOILER TUBES.
(2) 162 PAIRS WHEELS and AXLES for CARRIAGES and WAGONS.
(3) ONE 5-TON and ONE 10-TON HAND POWER TRAVELLING CRANES.
(4) 4579 TONS STRUCTURAL STEEL WORK for LOCOMOTIVE SHOPS (together with Asbestos Sheeting, Patent Glazing, C.I. Piping, &c. &c.).
Tenders are due in as follows :—
Nos. (1) and (2) by 2 p.m. on Tuesday, 21st August, 1928.
No. (3) by 2 p.m. on Tuesday, 28th August, 1928.
No. (4) by 10.30 a.m. on Thursday, 20th September, 1928.
Tender forms obtainable at address below; fee One Guinea each, which is not returnable.
The Directors do not bind themselves to accept the lowest or any Tender.
Company's Offices :
25, Buckingham Palace-road, Westminster, S.W. 1. 9197

Abertillery and District Water Board.
SALE OF PLANT.
The above Board offer FOR SALE extensive ELECTRICAL, STEAM, and other PLANT, recently used in the construction of a large Concrete Masonry Dam.
The following are some of the principal items :—
Generating Plant, consisting of No. 2 Ruston and Hornsby 230 H.P. Gas Engines and Producer Plants with No. 2 Metropolitan-Vickers 150-kW, 500-volt Dynamos.
No. 1 100 H.P. National Gas Engine and Producer Plant with No. 1 Bruce-Peebles 100-kW, 500-volt Dynamo.
No. 4 Anderson-Grice 2-Ton, 3-Motor Electric Loco. Cranes.
No. 3 Steam Derrick Cranes, 4 and 5 ton.
No. 1 14in. by 12in. Ingersoll-Rand Air Compressor with 500-volt Motor.
No. 1 Double Concrete Hoist, 180ft. high, by Stothert and Pitt, with Trussed Steel Chutes, Hoisting Winches, ¼-Yard Mixers, and 500-Volt Motors.
No. 2 Steam Locomotives, 3ft. gauge.
No. 2 Victoria Concrete Mixers, ½ and ¾-yard capacities.
Further particulars can be obtained from the Board's Engineer, Mr. J. FRANCIS JUPP, M. Inst. C.E., Midland Bank Chambers, Newport, Mon. 9091

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PUBLIC NOTICES

Bombay, Baroda and Central
INDIA RAILWAY.
PRODUCTION ENGINEER.

REQUIRED for service in the Central Shops, Ajmer (Locomotive Dept.), a

PRODUCTION ENGINEER.

Candidates should be between 25 and 35 years of age, and preferably unmarried.

QUALIFICATIONS REQUIRED.

(i.) A sound knowledge of modern production methods, with special training in machine shop practice. Must be capable of introducing new production methods in a large engineering works.

(ii.) Must be a good designer of jigs, tools and fixtures, and able to make tool lay-outs for all classes of machine shop work.

(iii.) A sound knowledge of planning and rate fixing. Must be capable of laying out detailed manufacturing operations, estimating times, and detailing the type of machines on which parts are to be manufactured.

(iv.) Must be prepared to supervise demonstrations of operations of all classes of machine tools used in a large machine shop.

(v.) Must possess a good knowledge of inspection methods and gauging systems. This is essential.

(vi.) Should have held the position of either Production Engineer, Head Planner and Rate Fixer, or Machine Shop Manager in a large engineering works.

(vii.) Locomotive and carriage and wagon experience not essential.

Candidates must possess a good general and technical education and preferably hold a recognised Engineering Degree or Diploma.

TERMS.—Three years' agreement in the first instance, and service may be continued if agreeable to both parties. Free first-class passage to India and home again in accordance with rules and regulations, &c.

SALARY.—Rupees 740 plus £30 overseas allowance per calendar month.

The selected candidate will be required to pass a strict medical examination before appointment.

Applications (by letter only), giving full particulars of general and technical education and honours gained (if any), age and whether married, together with details of training and experience in chronological order (with dates), and COPIES ONLY of testimonials, must be addressed to the undersigned not later than 22nd August, 1928.

S. G. S. YOUNG,
Secretary.

Offices: The White Mansion,
91, Petty France, Westminster, S.W. 1,
30th July, 1928. 9196

Cheshire County Council.
MAIN ROADS AND BRIDGES DEPT.

The Cheshire County Council REQUIRE the SERVICES of a RESIDENT ENGINEER to Superintend Construction of Reinforced Concrete Bridge and about 2¼ Miles of Main Road Reconstruction. Must have had responsible charge of similar works. The person appointed will be required to enter into an agreement and the appointment will be temporary only, and, subject to satisfactory service, will be for a period of about two years. Salary £600 per annum.

Applications, together with particulars of previous experience and copies of three recent testimonials, to be addressed to the undersigned in sealed envelopes, marked "Resident Engineer," and received not later than Monday, 20th August, 1928.

G. E. ASHFORTH, M. Inst. C.E.,
County Surveyor and Bridgemaster.

County Surveyor's Office,
The Castle, Chester.
1st August, 1928. 9208

County Borough of Wolverhampton.
WATER DEPARTMENT.
JUNIOR ENGINEERING ASSISTANT.

APPLICATIONS are INVITED for the POST of JUNIOR ENGINEERING ASSISTANT in the Water Department, at a salary of £200 per annum, subject to percentage deductions in accordance with the Local Government and other Officers Superannuation Act, 1922. The selected candidate will be required to pass a medical examination.

Applications, stating age, qualifications and experience, together with copies of three testimonials, must be delivered to the undersigned on or before 20th August, 1928. Envelopes are to be endorsed "Junior Engineering Assistant."

F. E. WARBRECK HOWELL,
Town Clerk.

Town Hall, Wolverhampton,
3rd August, 1928. 9173

Electrician Fitter Wanted

IMMEDIATELY for Engineering Maintenance Work at the SURREY COUNTY SANATORIUM, Milford, Surrey. Applicants must give proof of technical knowledge in steam and electrical departments, and have experience in boilers, pumps, D.C. generators, switchboard and refrigerators. Salary at the rate of £160 p.a., together with (a) house (rent and rates free) and water supply, or (b) lodging and washing. Age preferably not to exceed 35.

The appointment is subject to the provisions of the Local Government and other Officers Superannuation Act, 1922, and to the Standing Orders of the Council.

Applications, stating age, qualifications and experience, together with copies of recent testimonials, should be made on the prescribed form and sent to the Medical Superintendent, Surrey County Sanatorium, Milford, Surrey, from whom copies of the application form may be obtained and to whom all enquiries relating to the appointment should be addressed.

DUDLEY AUKLAND,
Clerk of the County Council.

County Hall, Kingston-on-Thames,
31st July, 1928. 9200

Metropolitan Borough of Greenwich.
APPOINTMENT OF BATHS SUPERINTENDENT ENGINEER.
AMENDED ADVERTISEMENT.

The Council of the Metropolitan Borough of Greenwich is prepared to receive APPLICATIONS for the APPOINTMENT of a SUPERINTENDENT ENGINEER at the Public Baths and Washhouses, Trafalgar-road, Greenwich.

The inclusive salary will commence at the rate of £400 per annum, rising by three annual increments of £20, £20 and £10 respectively to a maximum of £450 per annum, with residence, fuel and light.

The appointment will be subject to the provisions of the Council's Superannuation Act.

Applicants must be duly qualified engineers and have had experience in electrical plant and be capable of the management of a public baths establishment.

Applicants who have already applied for this appointment need not apply again, as their applications will be re-considered.

Applications must be in the handwriting of the applicants on forms to be obtained from the undersigned and must be accompanied by copies of not more than three recent testimonials, such applications to be sealed and endorsed "Baths Superintendent Engineer," and must be received here not later than 10 a.m. on Friday, the 17th August, 1928.

The appointment will be terminable by one month's notice in writing on either side.

Canvassing members of the Council, either directly or indirectly, will be a disqualification.

Stamped addressed foolscap envelope must accompany application for form.

FREDERICK J. SIMPSON,
Town Clerk.

Town Hall, Greenwich, S.E. 10,
July, 1928. 9168

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED for a Firm of Cement Machinery Manufacturers, ERECTING SUPERINTENDENT. Must have first-hand knowledge of Burning and Running Rotary Cement Kilns. Only those with above experience need apply.—Address, giving age, experience, and salary required, 9195, The Engineer Office. 9195 A

SITUATIONS OPEN (continued)

WANTED for Cement Machinery Manufacturers, DRAUGHTSMEN, experienced in the design of Cement Machinery and Plants. Only those with this experience need apply.—Address, giving age, salary, and experience, 9196, The Engineer Office. 9196 A

WANTED IMMEDIATELY for India, CEMENT WORKS MANAGER; must be very capable man, used to wet process and rotary kilns, one with Chemical or Engineering Training preferred. Three years' agreement, passage out and home.—Address immediately, giving full particulars as to experience and salary required, P4779, The Engineer Office. P4779 A

A LARGE FIRM of ENGINEERS REQUIRES a SALES REPRESENTATIVE for their London office staff, to assist in maintaining and increasing the sales of their Gasworks, Chemical and Allied Plant in London, the Home Counties, and S.E. England. Actual gas engineering experience will be considered advantageous. Complete particulars should be forwarded by applicants.—Address, 9184, The Engineer Office. 9184 A

APPLICATIONS are INVITED for the POST of MECHANICAL ENGINEERING INSPECTOR.

Candidates must be between 28 and 35 years of age and must have had a first-class general education, at least three years' practical training and five years' drawing-office experience, with a well-known firm of general mechanical engineers, and recent experience as a full-time Engineering Inspector.

Apply in the first instance by letter, stating age, qualifications, experience, and salary required, to BRUNNER, MOND and CO., Ltd., Northwich. 9199 A

CHEMIST.—WANTED IMMEDIATELY, First-class experienced CHEMIST for private Cement Works in India; must be young, energetic man, and capable of Taking Complete Charge of the Manufacture of Portland Cement in all its branches. Three years' agreement, with passage out and home, and furnished quarters. Good climate.—Address, giving full particulars of experience and salary required, P4778, The Engineer Office. P4778 A

ENGINEER.—WANTED IMMEDIATELY, First-class MECHANICAL ENGINEER for private Cement Works in India; must be young, energetic man and capable of Taking Complete Charge of Boilers, Turbines and all Cement-making Machinery. Three years' agreement, with passage out and home, and furnished quarters; good climate.—Address, giving full particulars of experience and salary required, P4777, The Engineer Office. P4777 A

EXPERIENCED Efficiency EXPERT REQUIRED to help improve efficiency methods in large factory, and work in close contact with members of existing organisation, particularly assisting Works Supervisory Staff in the arrangement and system of their shops.—Address, 9211, The Engineer Office. 9211 A

REQUIRED for Important British-owned Railway in Argentina, ENGINEERING DRAUGHTSMAN, neat and accurate and experienced in planning of tracks in stations, classification yards and goods yards. Must have a sound knowledge of general railway construction, including drainage and earthworks. Salary on three years' contract £400/£450/£500 per annum. Age not over 35.—Write, giving full particulars education, training and experience, age, single or married, with copies (only) of testimonials, to Box Y.T.R., c/o Davies, 95, Bishopsgate, E.C. 2. 9185 A

SUPERINTENDENT WANTED IMMEDIATELY by progressive works manufacturing ferrous and non-ferrous light repetition work, such as steam and water valves, pipe fittings, &c., on mass production lines. Applicant must have real practical foundry and expert machine shop knowledge relating to above products and be of good personality and able to command the respect of his workers by "knowing his job." Permanent position to energetic and progressive man who is willing and able to meet above requirements.—Write in confidence, stating full experience, salary required, and date when free, to "A. T.," c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, E.C. 2. 9190 A

TURBO-COMPRESSOR DESIGNER.—An Experienced MAN REQUIRED, capable of Taking a Leading Position in Drawing-office.—Apply by letter, stating age, previous experience and salary required, to REAVELL and CO., Ltd., Ipswich. 9085 A

WELL-TRAINED and Educated MECHANICAL ENGINEER WANTED, age 25-30, to Train as Assistant to Chief Designer in London Engineering Firm. Good opening for serious worker.—Address, P4827, The Engineer Office. P4827 A

WANTED, DRAUGHTSMAN, Thoroughly Experienced in the design of Hydraulic Presses and Pumps of all kinds, more especially Baling Presses.—Address, stating age, salary, full details experience, when at liberty, 9180, The Engineer Office. 9180 A

WANTED for the Engineering Dept. of a London Industrial Concern, a capable DRAUGHTSMAN, to Take Charge in Drawing-office and be of personal assistance to the Chief Engineer. None but those of proved ability and with wide experience in Factory Lay-out, with constructional and administrative experience, need apply. Address applications, stating salary required, with copies of references, which will be treated in strictest confidence, 9141, The Engineer Office. 9141 A

DRAUGHTSMAN, Junior, with Pumping Machinery experience, REQUIRED for East Midlands. State experience, previous employers, age, salary required.—Address, 9209, The Engineer Office. 9209 A

DRAUGHTSMAN, Railway Carriage and Wagon, WANTED, experienced man for taking out quantities.—Apply by letter, stating experience and salary required, to the BIRMINGHAM RAILWAY CARRIAGE and WAGON CO., Ltd., Smethwick. 9202 A

DRAUGHTSMAN REQUIRED for Electric Crane Work. Preference given to one with good experience in shop details, Jib and Wharf Cranes. Able to prepare stress stability diagrams and accurate estimating weights.—Address, stating age, experience, salary, P4833, The Engineer Office. P4833 A

DRAUGHTSMEN REQUIRED, Seniors and Juniors, for Bridge and Constructional Steel Work. First-class men only need apply, giving particulars of experience and salary required.—THE HORSELEY BRIDGE and ENGINEERING CO., Ltd., Tipton. 9171 A

DRAUGHTSMAN REQUIRED, Used to Producing Projects and Schemes for Conveyors and Mechanical Handling of Coal and other Materials. Only first-class experienced men need apply. State experience, age, and salary required.—Address, 9062, The Engineer Office. 9062 A

FIRST-CLASS HEATING ENGINEER DRAUGHTSMAN REQUIRED, capable of taking charge of drawing-office. A worker with initiative required.—Address, 9177, The Engineer Office. 9177 A

FIRST-CLASS WATER-TUBE BOILER DRAUGHTSMEN REQUIRED, with experience in designing and making up details, also accustomed to estimating. Good prospects for suitable men. Applicants to give full details of past experience, stating age and salary required and when able to commence.—Address, 9166, The Engineer Office. 9166 A

GOOD DRAUGHTSMAN REQUIRED, Steel Work, Pneumatic and Mechanical Conveying and Elevating Plants. State salary and when at liberty.—Address, 9179, The Engineer Office. 9179 A

INDIA.—Experienced CARRIAGE and WAGON DRAUGHTSMAN REQUIRED for Rolling Stock Department of large Engineering Works. Five years' agreement, free passage out and home. Unmarried man, 25 to 28 years. Salary according to capabilities.—Write, with details of experience, to Z.C. 317, c/o Deacon's, Fenchurch-avenue, London. 9188 A

SITUATIONS OPEN (continued)

JUNIOR DRAUGHTSMAN, with Good Works Experience, REQUIRED for details of Electrical Instrument Work. Must have a good technical training. Temporary in first instance, with excellent training and prospects of being made permanent. Full details of experience, &c., essential.—Write, Box 1186, Rays, Cecil-court, London, W.C. 2. 9201 A

LADY TRACER WANTED (London District) for general arrangements and shop details. Must be neat and accurate.—Address, stating age, experience, and salary required, 9206, The Engineer Office. 9206 A

RAILWAY CARRIAGE and WAGON DRAUGHTSMAN REQUIRED, with experience in production of drawings for all classes of Railway Rolling Stock, for home and export.—Address, giving full details of experience, age and salary required, 9214, The Engineer Office. 9214 A

THE SERVICES of a Capable MECHANICAL DRAUGHTSMAN REQUIRED by a Midland firm. Must have sound knowledge of Hydraulic Machines and Accumulators and capable of taking a leading position in drawing-office. Applicants must state age, previous experience, salary required, and when at liberty.—Address, 9175, The Engineer Office. 9175 A

WANTED, First-class FOREMAN ENGINEER, thoroughly experienced in maintenance of Chemical Plant. Only men with previous experience in this class of work and capable of controlling all classes of trades need apply.—Address, stating experience, &c., to Ref. 3D/, 9114, The Engineer Office. 9114 A

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Coal Chemistry in Germany.

THERE are indications of an understanding being come to between German coalowners and the powerful I.G. Farbenindustrie A.G., whose respective policies are tending to a destructive rivalry in which the coalowners themselves feel that they will be ultimately vanquished. Nothing can be gained on either side by such a competition. In the report recently published by the I.G. Farbenindustrie remarkable figures are given of the work accomplished by this vast organisation which was formed scarcely more than three years ago and is now one of the largest producers of all kinds of chemical and synthetical products. During 1927 the company supplied 550,000 tons of nitrogen from the Leuna factory, and this output will shortly be increased to 700,000 tons a year. It is now turning its attention more particularly to the hydrogenation of coal, for which vast works are being laid down, and it is stated that it will soon be capable of producing from 40,000 to 60,000 tons of benzine a year. The coalowners became alarmed at the activities of the I.G. Farbenindustrie, and those in the Ruhr stated to distribute their large surplus of gas by means of long-distance mains. At the same time they entered directly into competition with the big organisation by constituting the Ruhr-Chemie A.G., with a capital of 500,000 marks, which was subsequently increased to 27,000,000 marks, principally for developing the hydrogenation process. As this process is only beginning to enter upon a stage of industrial success the Ruhr-Chemie A.G. decided to give more attention, for the moment, to the synthetic production of nitrogen, for which purpose American capital has been obtained for the laying down of a factory near Sterkerade-Holten for the production of about 25,000 tons of nitrogen a year. It is, nevertheless, perfectly clear to coalowners that they are helpless against the overwhelming resources of the I.G. Farbenindustrie, and it is therefore regarded as fairly certain that the two concerns will come to some arrangement in their common interest.

Petrol Carrying Vessels in the Thames.

THE report of the boad of inquiry, consisting of Major T. H. Crozier, Chief Inspector of Explosives, and Professor J. S. S. Brame, of the Royal Naval College, Greenwich, which was appointed by the Minister of Transport to consider the proposal of the Port of London Authority to allow petrol and oil-laden ships to proceed up the Thames as far as Purfleet, has now been considered by the Ministry in conjunction with the other Government Departments concerned in this matter. On Monday of this week, when replying to a question in the House of Commons, Lieut.-Col. Wilfrid Ashley, the Minister of Transport, said that, after having considered the report in consultation with the other Departments concerned, he had reached the following decisions:—(1) That an alteration in the existing limit of navigation for petroleum tank ships was undesirable; (2) that ships carrying not more than 1000 tons of petroleum spirit or petroleum spirit and other petroleum in barrels or drums should be allowed to navigate the river Thames to and from Bow Creek; (3) that ships carrying not more than 2000 tons of petroleum spirit or petroleum spirit and other petroleum in barrels and drums should be allowed to navigate throughout the Port of London. The existing laws to which the Minister of Transport recommends that there should be no alteration permit petrol-carrying vessels to pass up the river only as far as the Mucking Light at Thames Haven, which is a little less than 7 miles below Greenwich.

Rural Electrification.

IMPORTANT recommendations on the subject of the supply of electricity in rural areas are contained in a report issued by the Electricity Commissioners on the conference which was convened at the end of last year to undertake a general survey of the position of rural electrification in this country. Two sub-committees have been engaged in investigating the nature and extent of the potential demand for electricity in rural areas, and the bearing and general effect upon rural development of the price of the supply and the cost of electrical equipment. The reports of the two sub-committees were generally adopted by the conference, subject in the case of certain of the recommendations to modifications and additions. It is recommended that the Commissioners should regard the development of electricity supply in rural areas as a special branch of their work, and that they should consider the advisability of appointing a special officer for the purpose. Although only a few months have elapsed since the Commissioners issued their new overhead lines regulations, it is recommended that a further review of the matter should be made with a view to reducing the cost of overhead lines by relaxations as regards ground clearance and factors of safety in respect of lines for supplying sparsely populated rural areas. The Commissioners are requested to urge undertakers to make a periodic canvass of the potential demand in the unsupplied portions of their areas, and to take steps to ensure that undertakers carry out their obligations in cases where there is a reasonable prospect of supplies being given on a remunerative basis. The sub-committee which investigated the question of the demand points out that for economic reasons rural electrification cannot be proceeded with to the extent of placing a supply of electricity at the service of every inhabitant, farm and other premises throughout rural Britain. The broad conclusion which this sub-committee has arrived at is that a potential demand growing to something like 230,000,000 units per annum in the course of the next ten years is indicated for the rural areas of Great Britain where supply powers already exist.

Low Temperature Carbonisation.

PARTICULARS regarding the progress of the "Laing and Nielsen" system of coal distillation may be gathered from the speech made by Lieut.-Colonel J. T. C. Moore-Brabazon, the chairman of "L and N" Coal Distillation, Ltd., at that company's first ordinary general meeting, which was held in London on Monday, July 30th. The 100-ton installation along with its briquetting plant, which the company has recently completed at the Ashby-de-la-Zouch pit of the Leicestershire Colliery and Pipe Company, has now been put into continuous operation, and on the technical side has, it is stated, exceeded expectations. Although designed for a throughput of 100 tons of coal per day, it is found that up to 140 tons can be successfully treated. With the New Lount coal from 13 cwt. to 14 cwt. of residual fuel are obtained, along with 20 gallons of oil for each ton treated. It is proposed to increase the number of retorts from one to five, which extension if carried out will enable 700 tons of raw coal to be treated per day, with a yield of nearly 500 tons of residual fuel and about 20,000 gallons, or nearly 60 tons of oil. The company's new refinery at Barnsley for dealing with the oil so produced is now completed, so that the commercial value of the "L and N" oils can be assessed. An agreement has been entered into with the Irish Coal Syndicate for the development of the "L and N" process in Northern Ireland for distilling the native shale and cannel coal, and negotiations are proceeding for the extension of the process to various foreign countries. Speaking at the same meeting, Mr. Frank Hodges pointed out that, as the amount of hard substitute fuel produced by the "L and N" process of distillation is only 14 cwt. per ton treated, for every 20,000,000 tons of raw coal now produced 29,000,000 tons would be required to produce the same amount of hard fuel, if all were to be distilled. Such an increased demand would be of immediate benefit to the coal industry.

Railwaymen's Wages.

THE opinion expressed by Mr. J. H. Thomas at Southampton, with which we concluded our note hereon last week, that the railway companies' proposals for reducing their wages bills were "unfair, disproportionate and one-sided," hardly prepared one for the quick and most satisfactory result achieved at the adjourned meeting on Friday, July 27th. The companies and men have agreed that on and after August 13th there shall be a reduction of 2½ per cent. in all wages, salaries and directors' fees. The agreement is for twelve months and to be thereafter terminable by three months' notice, such notice to be given by either side collectively. The companies have agreed that in view of these reductions the railway workshops shall be put on five days a week, if it is not possible for them to work full time. Shopmen also are to have their wages reduced. It has been said generally in the Press that the saving to the companies will be in the neighbourhood of £3,000,000 a year. That can hardly be so; the production of such a sum by a reduction of 2½ per cent. in the main amount would mean that the latter was £120,000,000. As the total expenditure of the railway companies in 1927, which included material, fuel, stores, and other items beside labour, was £160,000,000, we would be inclined to say that the savings would amount to £2,000,000—a very gratifying amount all the same.

Imperial Wireless and Cables.

THE report of the Imperial Wireless and Cable Conference, which was appointed to examine the situation which has arisen as a result of the competition of beam wireless with the cable services, advocates—as we anticipated in our issue of July 13th—the formation of a merger company to acquire, as from April 1st last, all the ordinary shares in the Eastern, Eastern Extension, and Western telegraph companies, and all the shares and debentures in the Marconi Wireless Telegraph Company. It also recommends the formation of a Communications Company to which the cable and Marconi companies will sell all their communication assets in exchange for shares. This company, whose capital is not to exceed £30,000,000 at first, will also acquire the Government cables and hold the lease of the Post Office beam stations. Control of the Governments concerned is to be by an Advisory Committee to include representatives of the Governments which participated in the Conference, and British control of all the companies must be guaranteed. The Conference consisted of representatives of the Governments of Great Britain, Canada, Australia, New Zealand, South Africa, the Irish Free State, and India, and a representative of the Colonies and Protectorates. The chairman was Sir John Gilmour. After outlining the history of the cable and beam wireless services, the report emphasises the necessity for the retention of the cable systems. It is considered important, for commercial and other purposes, that the majority of cables should be kept in operation.

Charing Cross Bridge.

ON Tuesday of this week, July 31st, the London County Council approved the Ministry of Transport's scheme for the construction of a road bridge at Charing Cross and the removal of the Southern Railway's Charing Cross Station to a site on the south side of the river lying between Waterloo Bridge and the existing Charing Cross railway and footbridge. The Council's approval of the scheme is subject to a grant from the Road Fund of 75 per cent. of the actual expenditure being made applicable to the whole scheme and to the Council's liability for its share in the cost of the scheme and of reconditioning Waterloo Bridge being restricted to £3,219,000. The report of the Improvements Committee on which the Council's decision to approve the scheme was based stated that four years had elapsed since the temporary wooden supports, on which the stability of Waterloo Bridge at present depends, were put in place, and that their life could not be indefinite. The Committee was also advised that the foundations of the temporary steel bridge erected close to the downstream face of the old bridge were not to be relied upon for any extended term. The Committee therefore urged that the time had come when an end should be put to the period of suspense, and that the question of Charing Cross Bridge having been settled quickly, steps should be taken without further delay to deal with Waterloo Bridge. The approval of the Southern Railway Company's shareholders now remains to be obtained before the scheme can be said to be fully accepted.

The Use of Ethyl Petrol.

IN view of the somewhat alarming statements which have recently appeared in the daily Press with regard to the use of motor spirit containing lead tetra-ethyl or similar lead compounds, the Departmental Committee appointed by the Minister of Health to inquire into the possible dangers to health which might result from the use of such spirit decided to issue an interim report. In this report, which was made public on Friday of last week, July 27th, the Committee makes the statement that after carefully considering the evidence it has taken, and the experimental work done in the United States bearing on the use of ethyl petrol, it sees no reason for prohibiting its use. It is recommended, however, that reasonable precautions should be taken, similar to those used in America and employed in this country by the distributors, and that ethyl petrol should only be employed as a motor fuel and not used either for cooking or cleaning purposes. The Committee emphasises the dangers of carbon monoxide poisoning arising in the case of unventilated garages, whether or not ethyl petrol is used. Further investigations are to be undertaken by the Committee with a view to confirming certain points in the work carried out in America, and studying some points not covered by that work. Tribute is paid to the readiness with which the United States Government has placed at the disposal of the Committee the results of the investigations which were carried out in America.

Wages of Coal Miners in Belgium.

DURING the year 1927 the average wages of all men employed in the coal-mining industry of Belgium amounted to 4·67s. per day of presence at the pits. Surface workers earned on the average 3·46s., workers at the face 5·73s., and underground workers in general, including the face workers, 5·14s. per day. The wages cost per ton of coal raised varied from 10·15s. in the Campine district to 7·16s. in the small Namur field, the average for the whole kingdom being 9·08s. per ton. It must be remembered that these wages do not represent the whole of the receipts of the workers. They generally receive in addition the "allocations familiales," or bonuses in respect of children, the benefits of accident insurance, pensions on retirement, and free fuel, but these advantages are not uniform, the practice varying in the different districts. From November 1st, 1926, to October 31st, 1927, miners' wages were regulated by an agreement arrived at in October, 1926. Under this agreement, an index number was computed by the addition of three-quarters of the "cost of living" index to one-quarter of the coal price index. This latter figure was taken as five times the price of steam coal as supplied to the National Railways. The agreement was not renewed, and wages are now regulated entirely by the "cost of living" index.

Dynamic Loading on Locomotive Wheels.

By Professor GEORGE LOMONOSSOFF.

No. III. (*Conclusion*).*

THE DYNAMIC VALUATION OF A LOCOMOTIVE.

HAVING now the experimental material, and using formula (10), it becomes possible to calculate Z for any locomotive experimented upon and for any wheel under any working condition. From the number of values of Z which it is possible to obtain, those having the most practical interest are the maximum and minimum for a given speed. These values, or rather curves, for Z—

$$\text{max. } Z = \varphi\,(V),$$
$$\text{min. } Z = \psi\,(V),$$

characterise with sufficient fullness a given locomotive viewed from the point of its vertical load on the rail.

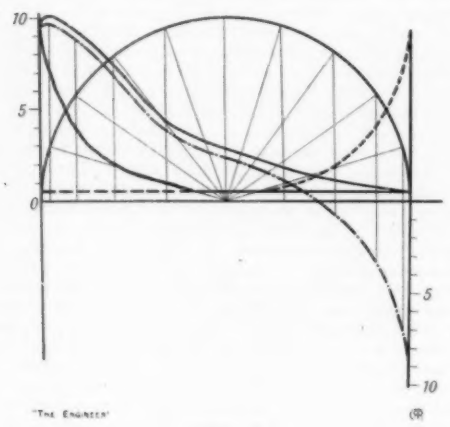


FIG. 5

They may be used for both rail and bridge calculations and for the determination of the limiting speed of traffic. For a closer analysis of bridge and permanent way phenomena, there are not only the curves of φ and ψ, but also the curves of $f\,(\alpha, V)$, even if only for the more usual work of the locomotive. The combination of all these curves goes to make up data which, since 1914, have in Russia been termed "the dynamic passport of a locomotive."

The determination of the maximum and minimum values of the function—

$$P_z = P + k\,z$$

presents no difficulty. Nevertheless, during the discussion of this subject at the Rail Commission in 1914, there arose a controversy as to which of the values of z should be entered in the dynamic passport—the largest recorded on a given locomotive axle or the average z_e obtained on all the trips. The latter was adopted, the following two considerations being put forward in support of it:—First, that the probability of the coincidence of the

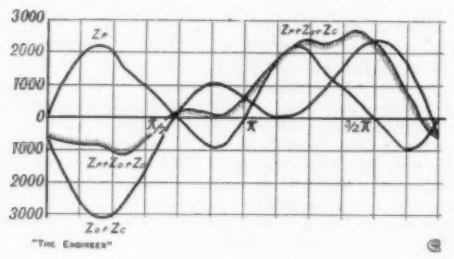


FIG. 6

maximum Z_a with the maximum $f\,(\alpha, V)$ is very remote, and, secondly, that it must be strictly avoided by limiting the speed of the locomotive on such parts of the permanent way upon which these readings of Z_a are likely to take place.

As regards the determination of the maximum and minimum—

$$Z_a = f\,(\alpha, V) = Z_o + Z_p + Z_e + Z_f,$$

the difficulty here lies in the fact that p_x and r_i depend not only on α and V, but also on the throttle opening ρ and the cut-off ε. Therefore, for the main driving axle the outline of the curve $f\,(\alpha, V)$ depends on the method of running, *i.e.*, on those combinations of ρ, ε and V which the engine driver uses.

During the tests of the Russian locomotives, from the experimental curve of the tractive effort—

$$F_i = \varphi\,(\rho, \varepsilon, V),$$

we obtain the formula necessary for practical purposes

$$F_i = \varphi_i\,(x, V),$$

by means of eliminating from the first ρ and ε with the help of the equations—

$$\Phi\,(\rho, \varepsilon, V, x) = 0$$
$$\Psi\,(\rho, \varepsilon, V) = 0.$$

Of these, the first expresses the condition that in order to actuate a given combination of ρ, ε and V it is necessary to obtain an amount x of steam from every square metre of the heating surface, and the second points out that the engine driver must so combine ρ and ε that the steam consumption of the engine for any speed shall be as small as possible.

Using the same method it can be shown that—

$$Z = f\,(\alpha, x, V),$$

but this raises the question as to which value for X should be entered into the dynamic passport. After a long discussion it was decided to take $x = 30$ for goods locomotives and $x = 40$ for passenger engines, which values correspond to their full output

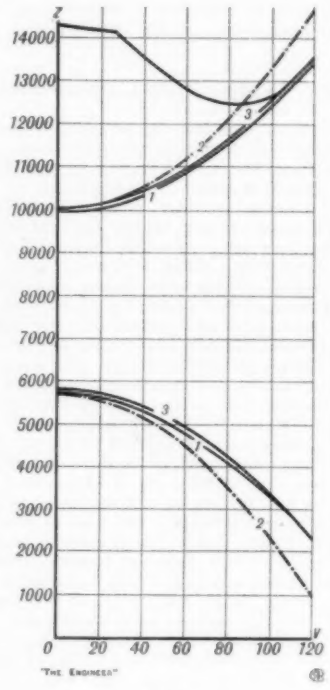


FIG. 7

on average Don coal. Experience, on the other hand, has shown that for the calculation of Z for the main driving wheels, it is necessary to check by using $x = \rho = 0$, since on many locomotives the minimum Z value occurs when running with a closed throttle.

Having first selected the indicator cards answering the given x and corresponding to the various speeds, the curves shown in Fig. 5 are drawn with a dotted curve for the counter pressure turned through 180 deg. Calculating the co-ordinates of this curve from the upper thick line curve, we obtain the dot-and-dash curve which gives p_x as the function of the movement of the piston. In order to determine the value of p_x for given values of α, say, for every 18 deg., the semi-circle is divided into ten parts, and the corresponding co-ordinates of the curve are measured.

After this has been done, the drawing of the curve of Z_p as a function of α presents no difficulty. Fig. 6 shows such a curve drawn for a two-cylinder single-expansion 2–6–2 locomotive, with values of $\rho = 1$, $\varepsilon = 0{\cdot}3$, and V = 110 kilometres per hour. For the same indicator diagram conditions, applying to Fig. 5, Fig. 6 is derived. In this figure the curve of the values of $Z_e + Z_o$ are also shown. As regards Z_f, as its values never exceed 85 kilos., the curve—

$$Z_p + Z_e + Z_o$$

can be considered to be a suffiicently accurate curve of $f\,(\alpha, V)$. This curve is in this case at a maximum value when $\alpha = 280$ deg., and the maximum then equals 2790 kilos. For the locomotive in question, on the main driving axle—

$$P = 7850 \text{ kilos.},$$
$$k = 127 \text{ kilos.},$$
$$z_b = 17 \text{ mm.},$$

and hence—

$$\text{Max. } Z = 7850 + 127 \times 17 + 2790 = 12{,}800.$$

This calculation was for the right-hand side, and for the left the value of + 13,150 kilos. was obtained. This value is plotted as a point corresponding to V = 110 on Fig. 7. If this operation now be repeated for a series of speeds, always taking the largest values of either the right or left-hand side, the top curve on Fig. 7 is obtained. On the other hand, for the determination of minimum Z, the smallest values are taken.

On the same drawing there are plotted the curves for the other axles, their order being indicated by the Roman figures. The upper group of curves show maximum Z, and the lower minimum Z, while the dotted-line curves are those which were made when running with a shut throttle.

It is interesting to note that for the given locomotive, when coasting, with V = 120, the minimum load on the main driving wheels is 1 ton. This is inadmissible, as when running over curves a slight shock under such conditions could derail the locomotive. By the Russian rules a minimum value Z = 1500 kilos. has been fixed, which limits the speed of the locomotive under consideration to—

$$\text{Max. } V = 112 \text{ kiloms. per hour.}$$

For the locomotive 4–6–0 with Vauclain compounding, and very heavy balance weights, when V = 81, the rear axle is totally unloaded, and there were, in fact, in 1905–1906 derailments of the fast trains between Moscow–Kief on the Moscow-Briansk section, when these locomotives exceeded their speed limit of maximum V = 65 kiloms. per hour.

For the four-cylinder "de Glehn" compound 4–6–0 locomotives, on the other hand, for V = 120—

$$\text{Max. } Z = 11{,}500,$$

instead of the 2–6–2 locomotives with value 14,800, while—

$$\text{Min. } Z = 5300$$

instead of 1000.

Referring again to Fig. 7, it will be seen that the curve of maximum Z for the main driving axle has a certain minimum value. This is explained by the fact that while Z_o and Z_e are proportional to the square of the speed, η p_x and therefore also Z_p decrease as the speed increases. For coupled axles where $Z_p = Z_e = 0$, maximum Z increases and minimum Z decreases with the increase of speed according to the parabolic law.

As we have already indicated, it may be necessary for special experiments to know not only the maximum and minimum values for the quantity $Z_p + Z_e + Z_o$ under certain conditions, but also to know the law by which this quantity changes with the change of the angle $\alpha = \omega\,t$. For the purpose of determining this law, a diagram similar to that illustrated in Fig. 7 can be employed. Russian civil engineers, however, acting on the suggestion of Nikolajeff, prefer to use diagrams with polar co-ordinates, similar to those illustrated in Fig. 8.

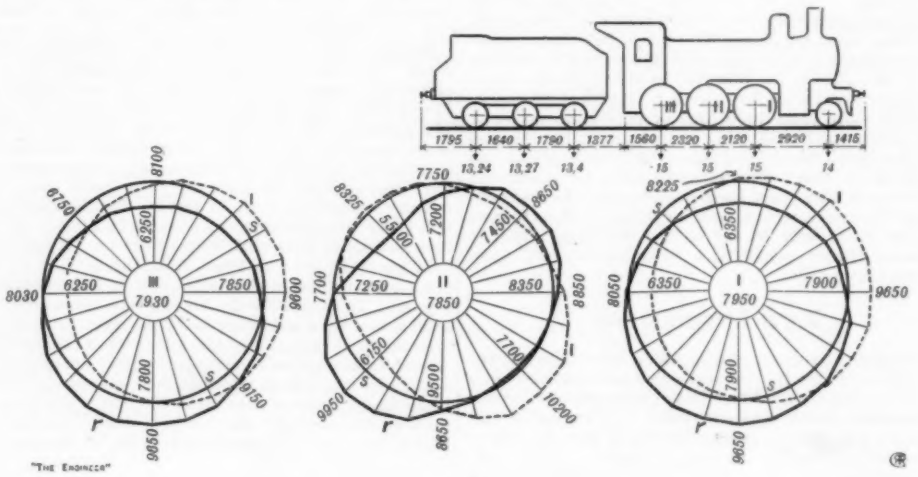


FIG. 8

All the forces Z, which have been mentioned, are considered to be applied at the wheels. When running they are also applied at the rail the inertia force of the wheel and half the axle which are dependent on the shape of the trajectory of the wheel centres. When the permanent way is good and the wheel is without flats, this force is a very small one, but with badly joined rails and worn wheels, and also on all metal bridges, it can assume considerable proportions. It is worthy of note that on electric and Diesel-electric locomotives which have low-hung electric motors, these forces are much greater than on a steam locomotive. In such a case, it becomes necessary to consider not only the mass of the wheels and half the axle, but also the mass of a large part of the electric motor. On the whole, however, the action of these

* No. II. appeared July 27th.

locomotives on a fairly good road is less than that of a steam locomotive, as with them—

$$Z_p = Z_e = Z_o = 0.$$

This action is still less for a turbine locomotive, and with a Diesel locomotive fitted with mechanical transmission.

As regards Diesel locomotives having cylinders similar to those of a steam locomotive—Dunlop, Shelest, &c.—they are in no way different from a steam locomotive. In both cases the springs and the relative position of the cylinders play the principal part, but with three or four cylinders, ordinary connecting-rods, there is practically no difficulty in making $Z_o + Z_e$ approximately equal to zero.

The Valley Bridge, Scarborough.

THE old Valley Bridge connecting the northern and southern parts of Scarborough was completed in 1865. It carried an 18ft. roadway, with two footwalks of 6ft. width, and was composed of three spans of 183ft. each. The original spans each consisted of two wrought iron lattice girders of 15ft. depth, which were strengthened in 1911 by the insertion of a central girder of "N" type between the two lattice girders of each span. The cross girders were then supported in the centre off this new girder by cast iron packing pieces. The timber deck was replaced at the same time by a steel plate floor which carried a wood block roadway.

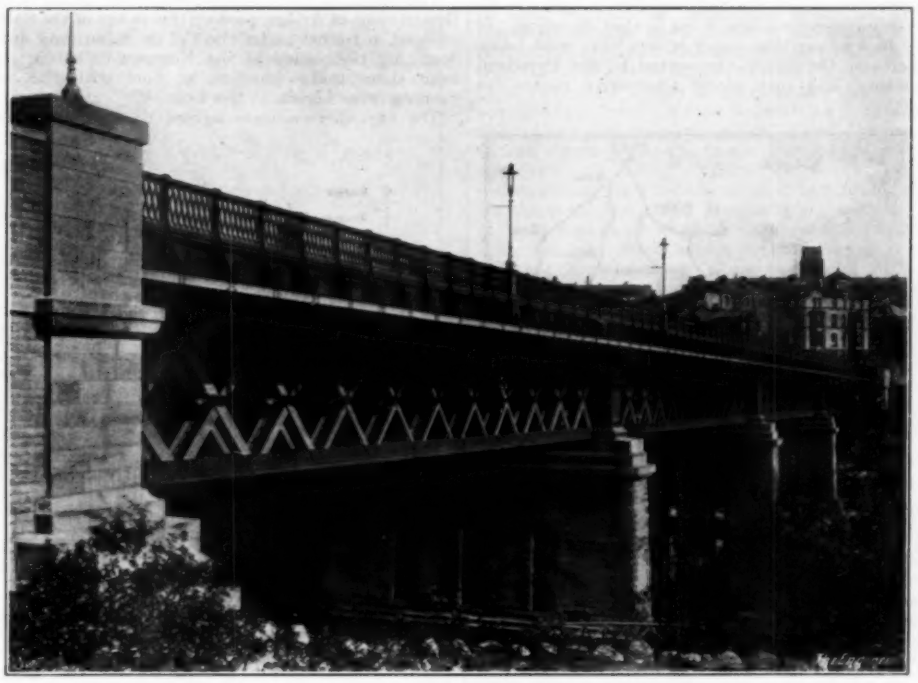
Owing to the narrowness of the roadway and to the unsatisfactory state of the masonry approaches it was decided in 1925 to reconstruct the bridge. The new bridge, which was formally opened by Mrs. Wilfrid Ashley on Thursday, July 26th, consists of four spans of 150ft. each, and provides for a roadway 40ft. wide with two footwalks each 12ft. 3in. wide. The abutments and piers are constructed of Bramley Fall and York stone masonry backed with concrete, and each span consists of four main girders of the double Warren type. The decking is formed of mild steel troughing, and is supported on cross girders at 12ft. intervals placed at the panel points of the main girders.

The foundations of the two abutments and of the centre pier presented no difficulty as good stiff boulder clay was encountered at some 12ft. below ground level. For the two piers on the sides of the Valley, the bottom of which is some 75ft. below road level, piles had, however, to be employed, as the foundations proved to be in soft material with no underlying strata of stiff clay at a reasonable depth.

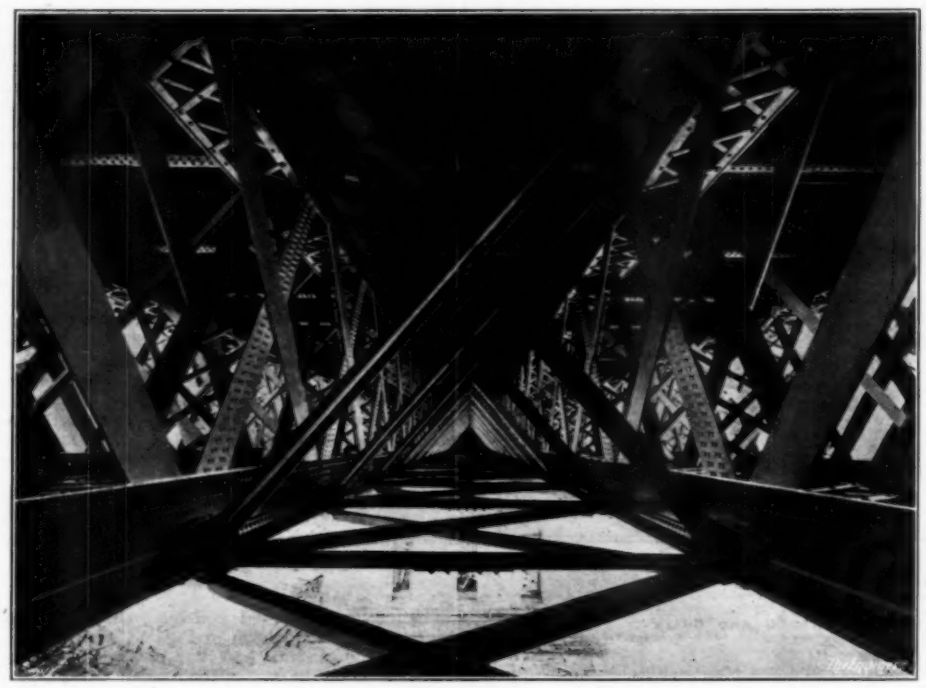
Ninety-six reinforced concrete piles were driven in each of these foundations, and, in order to avoid delay in waiting for the concrete piles to mature before driving, rapid hardening Ciment Fondu piles were constructed and driven within three or four days of pouring. Two electric 5-ton derricks with jibs of 90ft. and 100ft. were used for the setting of the masonry work of the piers.

One of the conditions of the contract was that the traffic on the old bridge was not to be interfered with, so that one half of the new bridge had to be completed first and the traffic was then diverted on to the completed half. The old bridge was then dismantled and the other half of the new bridge could be finished. This arrangement necessitated the construction of the abutments in two halves. The new piers, however, were spaced so as not to interfere with the old piers, and were consequently able to be constructed as one unit.

The steel work of the main girders for the one half span of the bridge was erected on temporary trestle stagings, and, when riveted up, the packings were struck and the stagings drawn through, for use first on the dismantling of the old bridge, and then on the construction of the remaining half of the new bridge. In order to avoid a delay of several weeks a temporary crossover from the completed portion of the new bridge to the old bridge was arranged in the middle of the bridge. This allowed the work of dismantling one of the old abutments and the construction of the second half of the new abutment to be put in hand whilst the first half of the new bridge was being finished off. By this means traffic was maintained without interruption. No use could be found for the main girders of the old bridge, so that they were cut down with oxy-acetylene torches and disposed of as scrap.



THE NEW VALLEY BRIDGE AT SCARBOROUGH



VIEW OF UNDERSIDE OF BRIDGE

The erection of the main girders was handled by a 5-ton steam crane travelling on the staging between the girders, whilst the cross girders and decking were erected by a 3-ton steam crane travelling on top of the completed decking. The riveting of the main girders on site was carried out with Boyer pneumatic hammers, and some 107,000 rivets were put in on site, the sizes of which varied from 2⅞in. to 6⅞in. in ⅞in. rivets and from 3⅛in. to 5⅛in. in ⅛in. rivets. The whole of the trough decking, bracings and parapet was bolted, and the total number of bolts used was 105,000.

In the abutments and piers there were 12,500 yards of concrete, 40,000 cubic feet of Bramley Fall stone, 3000 cubic feet of granite, and 4000 super yards of York stone. The Bramley Fall stone was obtained from Messrs. Whitaker and Sons quarries at Horsforth, near Leeds, the York stone from Messrs. Riley and Son's quarries near Halifax, the granite from the Shap Granite Company, whilst the ballast for the concrete was obtained by boats from the beach within a few miles of Scarborough.

The work was designed by Messrs. Coode, Fitzmaurice, Wilson and Mitchell, consulting engineers, of Westminster, and was carried out under their supervision, the resident engineer being Mr. R. D. Gwyther. The contract was let to John Butler and Co., Ltd., of Stanningley Ironworks, Stanningley, Leeds, who sublet the masonry work to Mr. F. W. Plaxton, a local contractor, and the erection of the steel work was sublet to Messrs. Ellis and Shaw, of 104, High Holborn, London.

The total amount of metal in the structure amounted to 2600 tons of steel work and 100 tons of cast iron work. The cast iron work was employed solely in ornamental work on the pier pilasters and ornamental panels in the handrail. The time of construction was estimated to take two years, but, owing to delays, due principally to the coal strike of 1926, it has taken just over three years to complete the work. The cost of the whole work amounts to approximately £158,000, of which the Ministry of Transport are contributing 65 per cent.

The bridge is an attractive structure and is probably one of the widest of its kind in the country. It will doubtless prove of great benefit to the town, particularly during the season when the traffic on the east coast route passing through the town is exceptionally heavy.

The Transpyrenean Railways.

UNTIL a few weeks ago the only ways of travelling from France to Spain, or *vice versâ*, by rail were either *viâ* Hendaye and Irun at the western end of the Pyrenees or *viâ* Cerbère and Port-Bou at the eastern end of that range of mountains—see Fig. 1. The distance in a strainght line between Hendaye and Cerbère is approximately 420 kiloms., or upwards of 262 English miles, and for the whole of that distance there was no direct connection by rail between the two countries. On July 18th, however, the line connecting Bedous in France with Jaca in Spain, which passes in tunnel beneath the Col du Somport, was formally put into service in the presence of the King of Spain and of Monsieur Doumergue, the President of the French Republic. The problem of forming a physical connection between France and Spain, which has been under discussion for upwards of half a century, has thus been partially solved, and within the next few years there should be two further direct railway

lines crossing the frontier. Our contemporary *Le Génie Civil*, in its issue of July 21st last, gives an excellent discussion of this important question, and the information contained in the following article has been obtained from that source, as have also the engravings with which it is illustrated.

Historial.

Our contemporary enters at considerable length into the history of the subject, but it will not be necessary for us to follow it far in that direction. It will suffice to say that many efforts have been made to overcome the obstacle presented by the Pyrenean Mountains, and that many alternative routes for

FIG. 1—RAILWAYS IN FRANCE AND SPAIN

railways have been discussed. As long ago as February, 1885, tentative agreements were come to for the construction of two lines:—

(*a*) From Bedous to Canfranc by the Somport; and

(*b*) From Saint-Girons to Sort by the Port de Salau.

Neither of these agreements was ratified, and nothing further was done till March, 1903, when the French Government took the initiative of proposing to the Spanish Government to substitute for the proposed line between Saint-Girons and Sort, another line between Ax-les-Thermes and Ripoll, by way of the Col de Puymorens. The routes of these three lines are shown on the accompanying map, Fig. 2. It may here be explained that in 1886 the French Midi Company had received sanction to construct a line from Saint-Girons to Oust, and another from Oloron to Bedous and that Spain had sanctioned in 1901 and 1902 the building of lines between Ripoll and Puigcerda and Ripoll and Ribas, but that the line from Lerida to Sort had not been sanctioned.

On August 18th, 1904, an International Convention was signed by Monsieur Delcassé, on behalf of France, and Sen. F. de Léon y Castillo, on behalf of Spain—which convention was modified by an additional protocol dated April 15th, 1908—which stipulated that three international lines should be constructed crossing the frontier in the neighbourhood of Puigcerda and Bourg-Madame, and near the Somport and Salau respectively.

It was agreed that the first line should start from Ax-les-Thermes in the Department of Ariège, pass in tunnel under the Col de Puymorens, cut the frontier in the neighbourhood of Puigcerda and Bourg-Madame, pass in tunnel under the Col de Tosas and effect junction at Ripoll with the line from Granollers to San Juan de las Abasadas.

The second line was to start from Oloron, in the Department of Basses-Pyrénées, proceed up the valley of the Aspe, pass in tunnel under the Col de Somport, enter the valley of the Rio Aragon, then pass to that of the Galego and make junction at Zuéra with the line from Saragossa to Barcelona.

The third line was to start from Saint-Girons in the Department of Ariège, pass up the valley of the Salat, proceed in tunnel under the Col de Salau, and enter Spain by the valley of the Noguera-Polleresa, and from there make junction at Sort with the line running from Lerida to the frontier.

The two Governments agreed to construct these lines, working together, within a period of ten years, the starting date being, in the case of the two first lines, the ratification of the Convention of August 18th, 1904, and as regards the third line, the completion of the line between Lerida and Sort. As a matter of fact the 1904 Convention was not actually ratified till January, 1907. The two first lines should, therefore, have been completed in 1917, but the war intervened and the financial difficulties of the after-war period still further delayed matters. However, finally, on May 17th of this year, a French electric locomotive passed through the Somport tunnel into Spanish territory, and it is probable that next year about the same time the Puymorens tunnel will be completed.

The Bedous–Jaca Line.

The new line which has just been put into service from Saint-Girons to Oust, and another from Oloron to Bedous and that Spain had sanctioned in 1901 and 1902 the building of lines between Ripoll and Puigcerda and Ripoll and Ribas, but that the line from Lerida to Sort had not been sanctioned.

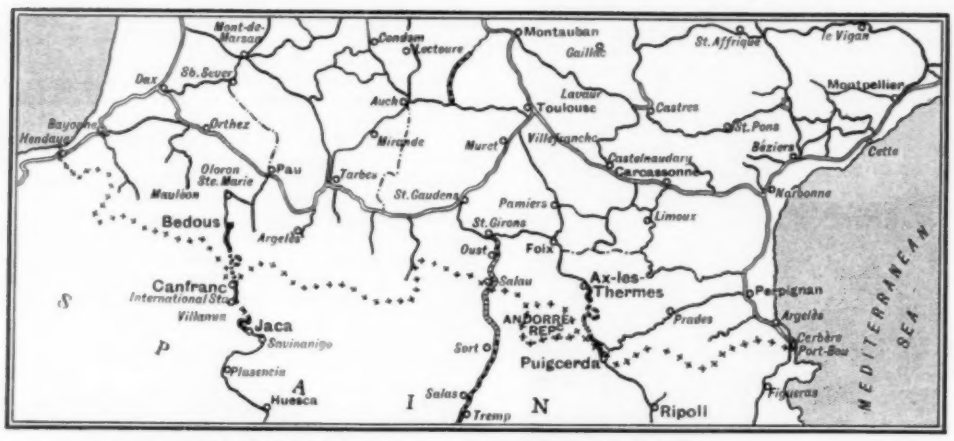


FIG. 2—MAP SHOWING RAILWAYS CONNECTING FRANCE AND SPAIN

The new line which has just been put into service is shown in profile and plan in Figs. 3 and 4 respectively. It starts from the station at Bedous, which is at an altitude of 406·5 m.—say, 1334ft.—and reaches the highest point of its course in the Somport tunnel at an altitude of 1211·65 m.—3975·4ft. From the southern portal of the tunnel the line descends by easy gradients to the international station of Arañones, which is situated near Canfranc, at an altitude of 1195·88 m., or 3924ft. On the way from Bedous to the tunnel are the stations of Accous Halt — 1466·4ft.; Lescun - Cette - Eygun — 1647ft.; Etsaut—1945·6ft.; Urdos—2343ft.; and, finally, Les Forges d'Abel—3503ft.—just short of the French Portal of the Tunnel. The rise from Bedous to the highest point in the tunnel is, therefore, 2641·4ft. The length of the line to the frontier, which includes a length of 3100 m. of tunnel, is 27·819 kiloms., or, say, 17·3 miles. The culminating point in the tunnel is approximately 28·5 kiloms.—or very nearly 17¾ miles—from Bedous. The average rate of climb is, therefore, practically 150ft. per mile. The distance from the frontier line to the station at Arañones, or Canfranc, as it will apparently be called, is 5·18 kiloms. or just under 3¼ miles, and, as the station stands at an elevation of 1195·8 m., the drop from the culminating point in the tunnel is only some 52ft.

From Bedous to Etsaut the steepest gradient is 1 in 33⅓. Beyond that it reaches in two stretches as much as 43 mm. per metre, or about 1 in 23·26. Moreover, from the very start right up to the tunnel the line is very sinuous and curves of a minimum radius of 200 m.—or, say, 10 chains—are frequent. As the valley of the Aspe is narrow, viaducts and bridges are numerous, but, as a rule, the works are not of a heavy

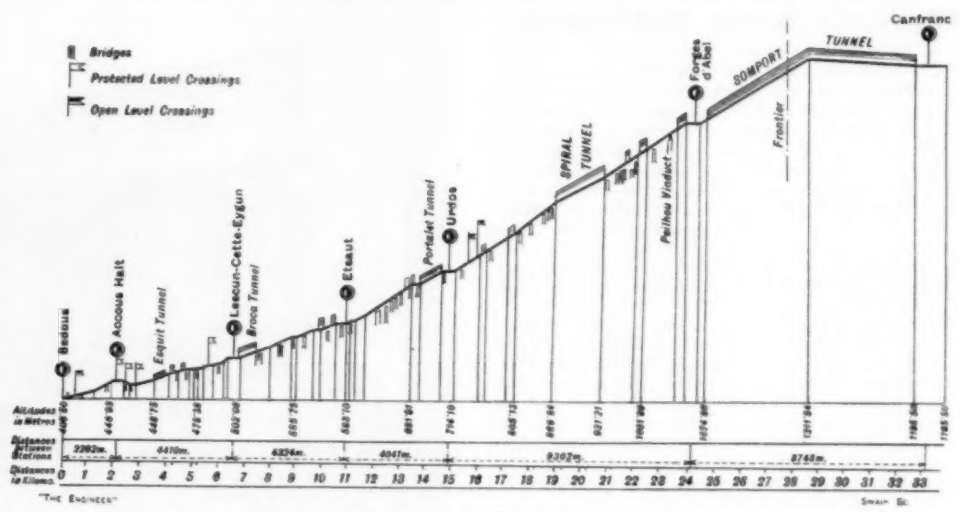


FIG. 3—PROFILE OF THE LINE BETWEEN BEDOUS AND CANFRANC

nature. The most important are three steel bridges of 50 m. span, and two of 60 m. span over the river, and two ashlar viaducts, those of the Arnousse and the Peilhou.

There are, in all, fourteen tunnels between Bedous and the frontier. The most important are—taking them in order—(*a*) Esquit, nearly 1500ft. long; (*b*) Broca, 2034ft.; (*c*) Portalet, 3094ft.; and (*d*) a spiral tunnel between Urdos and Forges d'Abel, 5824ft. long. In this tunnel the line rises just over 200ft., and from one point on the Route Nationale which traverses the neighbourhood, it is possible to see both its portals. The most important work of all, however, is the Somport tunnel, which pierces the Pyrenees proper. This tunnel, a profile of which is given in Fig. 5, is 7822 m.—4·86 miles—long, of which 3100 m. are in French and 4722 m. in Spanish territory. It is straight from end to end, and was pierced partly by the French and partly by the Spaniards. Actually, the frontier line is crossed at 3100 m. from the northern or French portal, but as there is a piece of level track, 100 m. in length, separating a gradient of 0·034 m. per metre, on the French side, and a gradient of 0·00429 m. per metre on the Spanish side, it was decided to take, as the dividing line between the work of the two countries, the middle of the level portion. The length of tunnel driven by the French was, therefore, 4012 m., and that driven by the Spanish 3810 m. The elevation of the line at the French portal is 1072·92 m. while at the Spanish portal it is 1195·5 m. The actual difference in levels between the two portals, therefore, is 122·58 m., or, say, 402ft. The tunnel, however, mounts considerably, reaching, as has already been said, an elevation at its highest point of 1211·65 m., so that the rise from the French portal is 138·73 m., which is effected in a length of 4012 m.—or at the somewhat steep rate of 1 in 28·9. The gradient on the Spanish side is considerably less steep, the fall being only 16·14 m. in a length of 3810 m., or at the rate of 1 in 236. The highest point in the mountain—the Pic de Tobaso—above rail level is 773·68 m., or some 2548ft.

Driving the Tunnel.

The method employed in driving the tunnel from the French side is shown in Fig. 6. First of all, a heading 2·30 m. wide and 2·2 m. high was driven at floor level on the axis of the tunnel. As this heading advanced it was enlarged to 2·75 m. wide in order to permit of the running of two parallel lines of 0·60 m. gauge service lines, and of the provision of channels for the compressed air pipes and for the evacuation of water met with in the operations. Secondly, a further heading with its top at approximately the level to be occupied by the vault of the completed tunnel was driven, and was connected to the first heading by means of vertical shafts, through which the excavated material was allowed to fall into trucks running on the lines in the lower heading for removal.

The upper gallery was then enlarged in stages for the formation of the vault of the tunnel by means of concrete blocks, which were put in position by the aid of metallic centerings. The rock between the two headings was then removed and the side walls and

their foundations put in, the masonry of the vault being meanwhile supported by shores.

The tunnel is lined throughout with artificial stone blocks, specially moulded to the required shapes in a yard near the tunnel portal. The concrete used was composed of 300 kilos. of slag cement to 400 litres of sand and 800 litres of gravel, which could pass through a 3 cm. ring. Nearly a million blocks, in all, were required, and for their consolidation in the moulds pneumatic tampers were employed. In order to facilitate the evacuation of water entering the works by infiltration, a layer of dry stones was arranged outside the vault and the side walls. This layer was

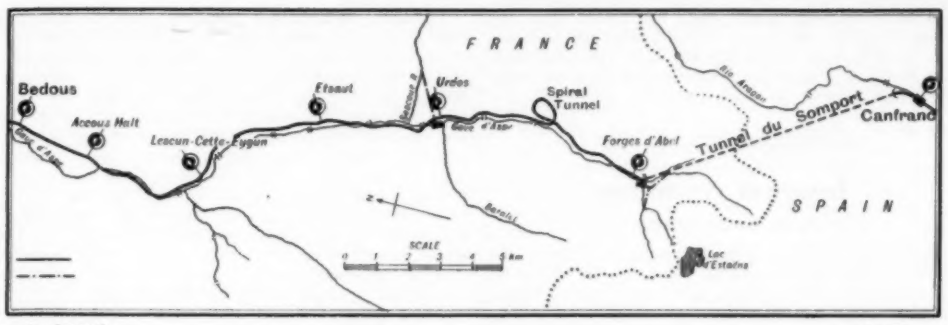


FIG. 4—PLAN OF LINE BETWEEN BEDOUS AND CANFRANC

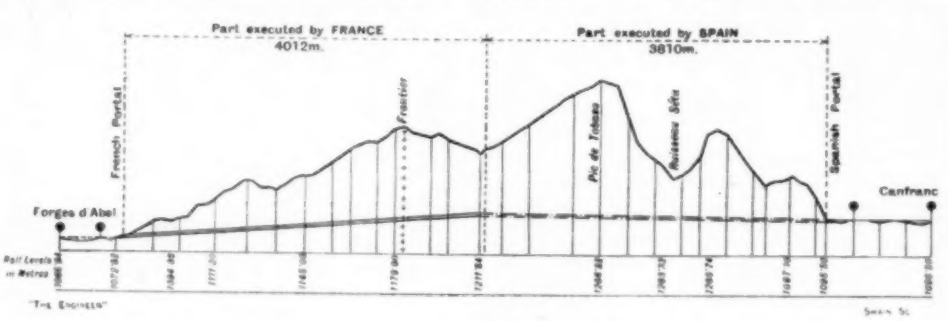


FIG. 5—PROFILE OF THE SOMPORT TUNNEL

0·1 m. wide, and it rested at the bottom on a footing of concrete. The water found its way into the tunnel—and thence to the portal—through apertures formed in the base of the side walls.

The rock traversed by the tunnel was a limestone, which was excavated with the aid of explosives without any particular difficulty being encountered. The blast holes were formed by means of pneumatic percussion drills, operating with an air pressure of 5 kilos. to the square centimetre—or just over 70 lb. to the square inch. They were from 45 mm. to 80 mm. in diameter and were some 2·5 m. deep. Two or three drills were operated on the working face simultaneously. The rock shot down was removed in

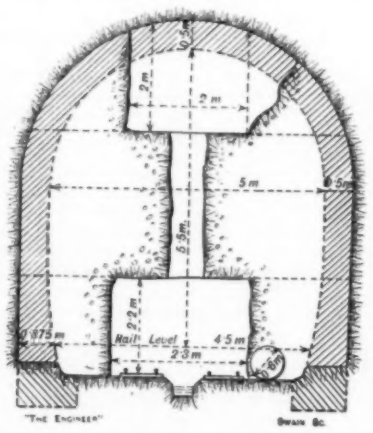


FIG. 6—SECTION OF SOMPORT TUNNEL

trolleys hauled by electric tractors. The necessary electrical energy was produced in a hydro-electric station specially constructed for the purpose before boring operations were begun. To supply the required volume of water, three barrages—one on the Aspe and one each on two of its affluents, the Gave d'Espelumguere and the Torrent du Couecq. The conduits from the three reservoirs thus formed were united in a single collector, 0·6 m. diameter, from which three pressure tubes, 0·35 m. diameter, conveyed the water to the generating station under a net head of 150 m. The generating units were Pelton wheels, each of 600 H.P. capacity.

PRELIMINARY WORK.

The country in the neighbourhood of the French portal of the tunnel, before the boring operations were begun, was entirely uninhabited. The entrance to the tunnel was 50 kiloms. from the rail head at Oloron, so that transport was a matter of difficulty. It was necessary to construct housing accommodation, &c., for the workpeople, of which some 700 were employed, as well as other buildings, such as a bakery, a school, an abattoir, and a gendarmerie. Then, too, repair shops, a saw mill, crushing machinery for producing sand, store houses, &c., had to be provided. The latter, since transport was impossible in winter time, had to be of considerable capacity. Transport was effected by means of horse or bullock wagons, motor lorries, which at the time the work was originally begun were not widely used, being only employed when speed in carriage was of importance.

The Report of the Hamburg Smoke Abatement Society for 1927.

By JOHN B. C. KERSHAW, F.I.C.

THE Hamburg Society for "Feuerungsbetrieb und Rauchbekampfung," is now in its twenty-sixth year of operations, and the report of its activities in 1927, which has just appeared, is quite equal to any of the earlier issues in technical interest and in its value to engineers. The writer has expressed his surprise before that no similar organisation for the suppression of smoke has been started in any of the leading cities of this country, for none of the existing societies concerned with smoke abatement is carrying on such useful work. A society organised on the lines of the Hamburg Society, if started in Manchester, Sheffield, or Leeds, should find plenty of scope, therefore, for its activities. Since it is not too late to hope that such a society may yet be founded in one of the industrial cities of the North, a few words about the organisation of the Hamburg Society may not be out of place here. In the first place, the German society is entirely voluntary in membership, and its operations are controlled by a Committee of practical business men. The following list of members of the Board for the current year bears out the truth of this statement:—Chairman, F. C. H. Heye, of the Firm Hermann Heye, the Glass Works, Hamburg; A. Bannwarth, managing director of the Hamburg Electricity Works; H. O. Traun, of the Firm Heinr. Traun and Sons, the Hamburg Rubber Company; R. Schroder, director of the Waterworks, Hamburg; W. Blohm, of the Firm Blohm and Voss, shipbuilders, Hamburg; Dr. Steinike, of the Firm Steinike and Weinlig; Hermann Thein, director of the Sugar Factory, at Stavenhagen.

The technical staff, which carries out the actual tests, comprises four University-trained engineers under the leadership of Dipl.-Ing. W. Burgdorff; and three foremen engineers, whose duties are to give technical instruction to the firemen in the works under the control of the Society; and, when required, to take sole charge of a steam-raising plant, in order to show of what it is capable under scientific management and control.

The chief engineer of the Society in his 1927 report states that, during the twelve months 1827, regular tests were made of boilers and heating plants belonging to members of the Society, and that, in addition, twenty-three special steam-raising tests were carried out, and twenty-five special efficiency trials. Other work of the Society's officers during the past year related to special investigations of new methods of firing and heating, and also to a series of tests of engine indicators and of the exhausts of turbines. The recent rise in the price of German coal has led to the increased use of English coal in Hamburg, and this substitution is likely to continue, so long as the present difference in prices holds. The English coal, however, is more difficult to burn without the production of smoke, and it therefore requires the exercise of more care on the part of the firemen. One of the chief difficulties met with by the Society's officers in their efforts to obtain higher efficiency is that so many steam-raising plants are overloaded, and that the boilers have to be worked above their proper steaming rate, in order to produce enough steam to run the power plant of the works or factory.

Concerning the progress of coal-dust firing in the Hamburg district, Herr Burgdorff states that from the technical point of view, the coal-dust system of firing can claim no advantage over mechanical stokers, and that the substitution of one system for the other, when it occurs, is due chiefly to the large increase in the size of boilers and furnaces. When the pulverised fuel, however, can be delivered at the burners at a lower cost than coal suitable for mechanical firing, the choice of the newer system is justified, and when, as in many cases, dust firing permits fuels to be burned which could not otherwise be used at all, the substitution of the one system for the other is only a question of time.

As regards the design of economisers, the chief engineer states that ribbed tubes are now in the ascendant, since an economiser fitted with them occupies less space, and the capital outlay is lower, than for one of equal capacity of the smooth tube type. It is essential, however, that the tube walls shall be kept clean and free from deposits of soot or dust, for otherwise the transfer of heat and the boiler draught are spoiled. The report closes with a reference to the trials of mechanical firing on ships, where the problem of its application is much more difficult than for land boilers, and is bound up with the question of obtaining better regulation of the external draught and of the forced draught in the boiler-room. The chief engineer states that the present system of firing ships' boiler under forced draught produces as much trouble and evil as the system of firing by hand, and in time it is hoped to find some satisfactory substitute.

The fifth section of the 1927 report is devoted to detailed figures of the improvements made in the efficiency of some of the steam-raising plants of the members of the Society, after they have passed under the control of its engineers. The first tests given are those made upon a hand-fired battery type of boiler, provided with a heating surface of 2150 square feet and with a grate area ratio of 1 : 25. The first test made with this boiler showed an efficiency of under 53 per cent., no less than 29 per cent. of the heat being lost in the chimney gases as sensible heat, and 6 per cent. as potential heat in the form of unconsumed hydrogen and hydro-carbon gases. These excessive heat losses were due chiefly to air leakage, and after a thorough overhaul of the boiler setting and brickwork and some instruction of the firemen in better methods of firing, the efficiency was increased to 71·7 per cent., which represented a saving of over one-third of the fuel used in the earlier trial. No economiser was provided for this boiler, and on that account the efficiency could not be raised much above 70 per cent., even under the best working conditions.

The next two tests show the value of the Hamburg Society's system of regular control of the ordinary member's plant, for these tests were made during surprise visits when the manager and firemen were not expecting the Society's officers, and the tests were made therefore under the normal conditions under which the boilers were operated. The boilers were of the Lancashire type with horizontal grates, and were provided, one with a smooth-tube and one with a ribbed-tube type of economiser. Each boiler had a heating surface of 3225 square feet, while the economiser, in the first case, had a heating surface of 2150 square feet, and in the second case of 3225 square feet, while the ratio of the grate surface to that of the boiler was 1 : 34·5 in the first case and 1 : 33 in the second. The tests showed an efficiency of 75·4 per cent. and of 74·4 per cent., these very satisfactory results being attributed to the careful choice and preparation of the fuel and to the good work of the firemen. The details of the two tests are given below:—

	No. 1.		No. 2.
Heat Utilised.			
Boiler	66·8		59·8
Superheater	6·0		8·8
Economiser	2·6		5·8
	75·4		74·4
Heat Losses.			
Chimney gases—			
Sensible heat	13·2		14·0
Unburnod gas	—		·8
Ashes and cinders	·9		·7
Radiation and other losses	10·5		10·1
	24·6		25·6
	100·0		100·0

Limits of space will not permit the other ten tests, details of which are given in the 1927 report, to be

dealt with at length, but it may be pointed out that the efficiencies of the boilers, superheaters, and economisers ranged from 74 up to 87·2 per cent., and that no fewer than eight of the tests revealed efficiencies of 80 per cent. or over. All of these high-efficiency tests were obtained with the modern boiler plants installed in electricity generating stations, and in order to enable these boilers to be worked considerably over their rated capacity the economisers were of exceptional size, and in most cases possessed double the heating surface of the boilers.

The best results were obtained with the Hanomag vertical tube boiler, having a heating surface of 8600 square feet, and provided with a travelling grate, the area of which in relation to the boiler heating surface was as 1 : 24. The economiser was of the ribbed-tube type, and had a heating surface of 16,512 square feet. The following are the results obtained at two different rates of combustion, namely, 19 lb. and 23 lb. per square foot of grate surface per hour:—

Heat Utilised.

	No. 1.		No. 2.	
Boiler	64·3		63·0	
Superheater	11·8		11·8	
Economiser	11·1		10·6	
		87·2		85·4

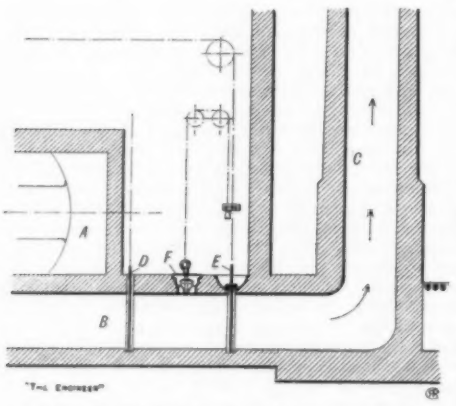
Heat Losses.

Chimney gases—				
Sensible heat	7·7		7·9	
Unburned gas	·6		·3	
Ashes and cinders	1·8		1·9	
Radiation and other losses	2·7		4·5	
		12·8		14·6
		100·0		100·0

Section VI. of the report is devoted to a discussion of the heat losses which occur when boilers are damped off during meal hours or during the night, and at week-ends when the works or factory are closed down. A German engineer named Praetorius has examined this subject, and has discovered that the losses arising from this cause are much larger than is generally assumed, and that they may even at times exceed the operating heat losses when the boiler is at work. They are due to the fact that no flue dampers are actually gas-tight, and to the constant leakage of heated gases past the dampers, even when they are supposed to be entirely closed. The usual type of revolving damper is worse than the vertical sliding damper as regards leakage, but neither one nor the other can be depended upon to stop all leakage of hot gases up the chimney.

An ingenious but simple method of reducing this leakage to a minimum when a boiler or battery of boilers is to be damped off, is described and illustrated in the report. It consists in providing in the main flue, or in the branch flue behind each boiler, a sliding damper which as it moves up or down operates an air valve fixed in the crown of the flue. When the boiler is to be damped off, either for an hour or two or for the week-end, both dampers are closed. The lowering of the second check damper then opens the air valve, and reduces the suction in the space between the two dampers to zero, and thus no hot gases can be drawn from the boiler or from the boiler flues while both dampers are closed.

Tests which have been carried out at the Hamburg



DAMPER-OPERATED AIR VALVE IN FLUE

electricity works with this device show that the overall efficiency of the plant can be raised from 2 to 3 per cent. by this means, and since the heat of the boilers and of the settings can be maintained over much longer periods of time when the boilers are damped off, a further advantage is that they can be much more quickly brought up to steaming temperature when again put into service. Boiler engineers are recommended therefore to adopt this device in all cases where the boilers have to be banked up during periods of idleness in the daytime or at week-ends, since in this way a considerable economy of fuel can be obtained.

The other subjects dealt with in the 1927 report are:—(1) The use of the exhaust steam from either turbo or reciprocating engines for heating purposes in works and factories; and (2) the use of automatic or other forms of gas-testing apparatus for checking the work of the firemen on each shift. As regards the first-named subject, illustrations are given showing the advantages of the rearrangement of the steam-raising plant in breweries, based on the use of the exhaust steam in place of live steam for heating the mash and other purposes, and some very striking diagrams indicate the advantages of this changed method of operating the plant. In one case a fuel economy of 23 per cent. resulted from the adoption of the new method of working.

As regards CO_2 testing apparatus, the report emphasises the importance of keeping all recording apparatus in perfect working order, since the effect upon the firemen and the efficiency of the boilers depends not only upon the test results but also upon the knowledge that there is a constant check being kept by automatic machines of the work done.

Internal Grinding.

By H. DARBYSHIRE.

From being a somewhat expensive luxury, the internal grinding of machine parts has of late years developed into an economical and important machining process. The common-sense provision of machines with rigid grinding wheel spindles and suitable wheels, and the addition of various semi-human mechanical features in their design, has made the rimer almost an obsolete tool, save in so far as unhardened work is concerned. With hardened material, grinding has rendered it possible to leave a more generous margin of stock for finishing processes, and has thereby minimised the danger of scrapping costly parts. Most of the prime advantages of modern grinding machines may be summed up in the few lines already written, but there are some other little points which do not readily meet the eye, and which, if once absorbed and kept steadily in mind, will do much to simplify the process and increase output. These little points may be best treated categorically, and perhaps the first in importance is that of suitable wheels.

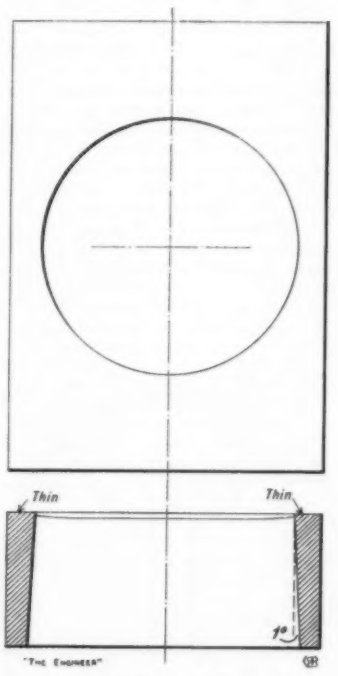
Grinding Wheels.

Internal grinding wheels should be chosen with an especial view to the conditions which are always present in this process of grinding. These conditions are the use of a more or less light wheel spindle, the greatest possible "arc of contact" or cutting surface between wheel and work, and, as a consequence, a greater generation of "heat" which is the constant enemy to successful grinding. In the face of these facts, and the additional fact that the size and hence the life of the wheel is limited by the size of the bore, the choice of wheel becomes a question of compromise. Taking the Norton Company's method of grading, a wheel of 46 grit, grade K, is the most satisfactory for grinding case-hardened or hardened steel bores. For bores of smaller diameter of the same material, 60 grit, grade J, may well be utilised, and for bores of, say, 3in. diameter and upwards, 36 grit, grade J, may be usually used to advantage for heavy stock removals, the final finishing being done with a wheel of finer grit, if extra refinement is necessary. Carborundum or Crystolon wheels are the best for cast iron, but the choice of grade and grit is usually a matter for a little trial and experiment; this by reason of the fact that cast irons are of a variable character. As an example, the cylinders of automobiles may be considered. They are usually made of a close grain and hard grade of cast iron, therefore a wheel of 46 grit will generally serve, if soft enough in grade. As the bore is fairly large in diameter, and its walls thin, a grade of wheel so soft as I may be necessary, or even H. The common-sense method, until the material is known and its peculiarities recognised, is to make experiment with the softest named wheel. If it should wear, or lose size quickly or cut too rank, a harder wheel is the obvious remedy. For bronze alloys which are variable in composition as is cast iron, similar reasoning is necessary in the choice of a wheel for grinding, erring, if anything, on the side of the finer grit. Chilled iron has a very hard surface which it is difficult to penetrate, and it is often best served with the finer grit wheels and a comparatively lighter depth of cut. This may be accepted as a general law, with any material of an extra hard and close-grained surface. The wheel, however, should never be crowded on to the work, as it is likely to load up and burn the surface.

Truing Wheels.—The only proper tool for truing a grinding wheel is a diamond point set firmly in a suitable holder and clamped firmly in position when in use. Means can always be devised, either by employing a hinged arrangement or other device, to put it out of the way when not in use, and the speediest arrangement is the best. It should be set exactly on the centre line and be traversed across the wheel face in the same plane of movement, and on the same side of the hole as that on which the grinding is done. This is the only proper way to ensure a cutting face on the wheel which is parallel with the wall of the bore, and to produce a surface finish free from score marks or mottled lines. A chunk of carborundum crystal or a wheel dresser may be used to score the wheel for rapid removal of stock, but the diamond point must always be used to finish. "Point" is used advisedly, although it must be considered approximately. A real point is something we cannot maintain, nor is it advisable; but as soon as a diamond shows any signs of dulling the wheel face it should be dismantled and reset. The omission to do so may, and does, lead to many misconceptions and loss of valuable time. A dulled grinding wheel has no more cutting virtue than has a dulled razor blade; it will either burnish the hole and give a false impression of finish and accuracy, or it may well lead to a quite suitable wheel being discarded as being too hard.

Mounting Wheels.—A grinding wheel is a rotary cutter, as is a milling cutter. Like the latter tool, to give its maximum of service, all cutting points should be equidistant from the axis of rotation. Hence, it must be truly cylindrical and the bore must be perfectly concentric with the periphery. Of the various devices employed for mounting internal grinding wheels, the writer favours the set-screw type as being the most satisfactory and convenient. It is adjustable for any width of wheel without having to resort to the use of packing washers or bushings which are rarely true, and which thereby put the wheel spindle out of balance. The only washers that are necessary, and, in fact, desirable, are those which can be made from thin pasteboard or ordinary blotting paper. These washers are best made by punching them out with a piece of tubing ground to a cutting edge at the mouth of the bore. The head of the holding screw should be as thin as possible and notched across for a lever or screw-driver. It is hardly necessary to say that this method of holding wheels only applies to grinding spindles of the solid type, which are always preferable for bores up to about 2in. diameter. Over and above that diameter the telescopic type of spindle is preferable, for the live portion of the spindle can be of a generous size.

Control of Temperature.—All modern types of external grinding machines are, or should be, fitted with a pump and circulatory apparatus to provide a generous supply of water, or other coolant, for the maintenance of an equable temperature of the work being ground. When we consider its many advantages, *per contra*, to its alleged disadvantages, no excuse for its absence can be justified. The only adverse criticism the writer has ever heard is that it is "messy," but as this defect can be countered by suitable fenders and reasonable precautions, it carries no weight. The advantages are so easily made apparent that there would seem to be nothing but petty reasons for its absence. Gauging is made a



SKETCH OF DIE

certainty in the minimum of time with the work kept cool and clean; on the contrary, with no cooling medium, gauging is an item of needlessly lost time with a risk of getting the gauge fast and disturbing the chucking of the work. An efficient coolant delivered at the grinding point in internal grinding acts as a lubricant to the cutting kernels in the wheel just as it does in external grinding processes. With work that is not uniform in section or that is held by special chucking devices, it is especially valuable, for it ensures a perfectly round hole given that the supporting spindle is a perfect cylinder. An ordinary die which is of uneven section or a ring held on a face plate by a pair of clamps or three clamps may be given as a striking illustration of this.

Take the case of a die of the shape shown in the sketch, the usual practice is first to grind out the bore to the specified size, and then grind out a relief portion of a contained angle of 1 deg. at the back; this latter being continued until the punch has a bearing of twenty or thirty one-thousandths of an inch of depth. Should the grinding be done dry this bearing will be found to be somewhat erratic in length, the longest

portion being on the two sides with the most material above the walls of the hole, the error being due to the natural laws of expansion.

In the case of the ring being ground dry the hole would come out somewhat elliptical in shape, the largest part of the oval being across the unclamped portion. If held with three clamps the error would not be so readily detected, but would show a three point bearing if tested with a round plug. A modern grinding wheel fed with an accurate micrometer feed is a reliable sizing tool, and in purely finishing processes may be relied on to duplicate sizes to within ·00025in. with commercial ease and speed. This, however, can only be achieved by safeguarding the work from erratic fluctuation of temperature.

Speed of Wheels and Work.

There is a kind of phenomenon connected with the speed of an internal grinding wheel which stands out distinct from other grinding processes, although surface grinding displays some affinity to it. First let it be said that the best results to be got in external cylindrical grinding are attained with a cutting speed of 6000ft. per minute; this for the average type of work. If this speed should fall below 5000ft. there is invariably a tendency for the wheel to load or crumble. Here we have the comparatively smallest contact area of wheel and work, and it is well to keep this in mind. In grinding a large diameter body such as a brake drum or chilled roll a reduced surface speed of wheel may be used without any ill effects provided the work speed is nor materially increased. In surface grinding a wheel surface speed of 4000ft. per minute is almost universally satisfactory. Here again we have increased contact area of wheel and work. With internal grinding a wheel surface speed of 2000 per minute is possible without any deleterious effects, which is a somewhat fortunate and economical fact. This brings us down to the consideration of the question of the relation of the diameter of the wheel to the diameter of the bore to be ground. With a short stiff spindle and a proportionate length of hole a wheel of about seven-eighths of the diameter of the hole may be used to commence with, although there may be some little trouble with glazing for a time. As the wheel wears down in size this trouble becomes proportionately less evident and when down to about three-quarter of the diameter of the hole it may be said to show the maximum of its efficiency and to maintain it until it reaches about one-half the diameter of the bore. After that it becomes next to useless, and can only be made useful at the expense of a marked reduction in work speed and loss of valuable time. In relation to this the writer has heard the opinion expressed by quite good men that atmospheric conditions have some effect on internal grinding wheels, and he has been asked the question in all seriousness when lecturing on the subject. If one takes into consideration the changes in surface speed of a given wheel at varying diameters and its varied effect on the work in hand the weather supposition seems reasonable.

As regards the surface speed of work there can be no fixed rule; about 50 surface feet per minute is a good average speed to commence with, and with a full size wheel it may be exceeded temporarily to minimise any liability to glaze. As the wheel wears down the work speed may be slightly reduced and the traverse increased as a compensatory measure. For the last few finishing cuts the work speed may with advantage be increased 100 per cent. and the finish materially improved thereby. It must not be inferred from what has been written that 2000 surface feet per minute is at any time a desirable cutting speed; rather may it be called a permissible one if no ready accelerating device is available. It also serves to illustrate the amount of wear and volume of work which is possible with these small wheels. As an example, we may instance a wheel of 1¼in. diameter at 14,000 revolutions per minute still being serviceable and efficient at one half its original diameter, although its surface or cutting speed is reduced 100 per cent. As opposed to this, in external cylindrical grinding, anything approaching such a drastic reduction would make grinding impossible.

Automobile Cylinders.

Reference has been made to automobile cylinders in connection with grinding wheels, and the practice that has been recommended is applicable to any cast iron body. These cylinders may be said to present a special internal grinding proposition owing to their variable sectional design. Single cylinders of the motor cycle type being fairly uniform in section, present few difficulties in the matter of control of temperature. With the duplex or mono-block type of cylinder casting the matter of temperature control becomes somewhat involved. The writer has seen many schemes tried for coping with the difficulty, such as filling the water jacket with a coolant or running a stream of water through the bore by way of the exhaust port. These, along with other somewhat similar measures, have never to his knowledge achieved the desired object—that is, to produce a cylinder bore that is perfectly round and parallel. It is some matter for regret that the real object of using a coolant in grinding processes does not seem to be generally appreciated. The object should be to prevent heat arising rather than to absorb it when it has arisen. The logic of this is that the coolant should be applied at the grinding point or as near thereto as is possible. As most cylinder grinding is done by the sun and planet type of machine there would seem to be some difficulty in directing the coolant directly on to the grinding point. As a suggestion the writer would like to propose the following method, which, in his opinion, would both achieve the object in view and offer other advantages. The bore of an automobile cylinder is generally large enough to admit of a segmental wheel being used, with all the advantages of enhanced production that comes from this type of wheel—as, for example, the heavy type open-side surface grinder with segmental wheel or wheels with a series of small holes from the bore of the wheel to its periphery. It should be possible to force the coolant through the wheel spindle and out of a series of holes between the wheel segments. Want of opportunity has alone prevented the writer from experimenting in this direction, but it seems reasonable to assume that it would meet with some measure of success. Care would be required in designing and making up the segment holder so as to preserve balance. It might be added that the fact of using a segment wheel would obviate the nice discrimination required in selecting the grade of wheel required. There is no system of "honing" that can salvage a distorted cylinder bore, for the very fact that its abrading segments are made resilient gives proof of this. The most they can do is to perpetuate the existing error and add lustre to it. There are many old machines in use to-day that can be brought up to date with some little renovation if the more primary features laid down here are given consideration; but in this, as in other matters, "it is the little things that count." The slovenly mounting of wheels on the part of the operator on the one hand and the parsimony or apathy displayed by the administration in providing suitable wheels are vital restrictive features to a profitable output. For the more precise work of the engineer a trim and balanced wheel, rigidly supported, means a bore that is as near perfection as possible; the opposite means either work of indifferent quality or a waste of valuable time spent in lapping with all its questionable results.

Just as the broad-faced wheel has proved its merits as a stock remover, so does the smaller diameter internal wheel as long as its supporting members be rigid enough. In fact, the necessity is greater, for the depth of cut is more limited than it is in external work and the chips escape less easily. Most operators make the mistake of feeding the wheel in too heavily or erratically and so load up the wheel. In external grinding a depth of cut of about ·003in. is permissible with a 36-grit wheel, but if more than one hair of this is applied internally the wheel will either load or crumble. The better way is to use a regular mechanical feed with a traverse almost the pitch of the wheel's width if possible and so get advantage of all its cutting area. For the final ·001in. or ·002in. the wheel should be dressed carefully, the work speed increased and traverse reduced and depth of cut to suit the class of finish desired.

It would perhaps be wise to be more explicit as to what is meant by rigid or stiff wheel-carrying spindles. A spindle 1in. diameter with a projecting length of 6in., supported in substantial bearings, would be a useful size for holes up to 6in. in length and, say, 2in. diameter for general purposes. On the other hand, for high productive purposes and to grind holes of 1¾in. diameter and 4in. long something better is desirable. For working such a type the writer would advise a spindle 1¼in. diameter with 4in. projection and would guarantee a 100 per cent. or perhaps still greater output. In fact, grinding is so rapid under such conditions as those advised that actual cutting time is a secondary consideration. Rather does it resolve into a question of scheming out the most rapid method of chucking and gauging the work. The conditions peculiar to our American friends have given impetus to a market for special purpose machines of the kind mentioned, and owing to the crude labour available many intricate devices are made a necessity and are an expensive feature of their design. We in this country are somewhat better placed, fortunately, up to the present and can readily meet all desired necessities. With regard to the grinding wheels specified in what has gone before mention was made of the Norton method of grading. This is merely a convenience for the writer and is no disparagement of anything in an excellent home market.

It might here be said that wheels for internal grinding always seem of a more effective quality if made up from broken segments of larger size wheels of the grades given.

The gratifying advance in grinding processes is by no means the last word in its practice. As a result of patient research, abrasives and their auxiliaries are being constantly improved upon and their applications proportionately enhanced. It is up to the progressive manager to keep conversant with these features and so bear a part in encouraging industry.

A note in a recent issue of *Nature* rather favours the idea that the water supplies of Dakota and East Central Australia are not artesian, but are produced from isolated lenticular masses of sandstone in clay, and that the water is forced up the bore-holes by rock pressure.

Gas Research.

The new laboratories of the Gas Light and Coke Company, at its Fulham works, which were formally opened by Sir Richard Threlfall on July 27th, are probably the most extensive and elaborately equipped in existence.

For their accommodation a handsome building of red brick and stone has been put up just inside the works gates, and conveniently handy to the retort house. There are three floors and a basement, which accommodate three laboratories and a library of some 4000 books. This library ,together with a conference room, are on an upper mezzaine floor. The No. 1 laboratory is on the first floor, and occupies a floor space of about 2700 square feet. It is to be used for general chemical work, and is stocked with appropriate reagents on shelves above the fixed benches. There is ample room between the benches, so that movable tables can be brought up if a larger arrangement of apparatus has to be used, while there are several "stink cupboards" in convenient positions. In it there are carried out such investigations as those on the thermal decomposition of methane and other gases, the recovery of benzol from gas by means of activated carbon, the analysis of low-temperature tars, gas analysis, pyrometry, and so forth. In the No. 2 laboratory, which is on the ground floor, there is a full-scale experimental plant for the recovery of benzol from coal gas by means of activated carbon, a briquetting press and apparatus for determining the combustibility of coke and for testing refractory materials. It is intended to keep this room as free as possible from fixtures, so that it may be used for work on a fairly large scale. There is ample provision of flue outlets concealed in the walls and the usual services of gas, air, vacuum, water and electricity.

The No. 3 laboratory, also on the ground floor, is devoted to such subjects as the dehydration of gas, gas analysis, the determination of the properties of gas, oil, benzol, coal, coke, tar, and ammonia. All the benches in the laboratories are so constructed that one-half may be pulled away to expose all the service pipes and drains. These services comprise high and low-pressure gas, coal gas for testing purposes—as distinct from the mixture of coal gas and carburetted water gas—compressed air, vacuum, water, steam and electric power at 220, and 2 to 15 volts.

In the basement there is a calorimeter room equipped with apparatus of the Thomas, Box and Boyes types; a photographic dark room, and an optical room. An air compressor, gas compressor, vacuum pump, water still and motor transformer are all housed in the basement.

For the purposes of carrying out large-scale experiments there has been installed in the works a pair of full-sized horizontal retorts in a special setting. They are served by a Guest-Gibbons charging machine, and equipped with a weighbridge and all the apparatus necessary for testing the gas. The whole of the gas is not passed through the apparatus, but, say, 5 per cent. is used for that purpose, and the remainder is sent to the works mains. The total amount of gas made ,and the quantity used for analysis are measured by two meters geared together.

At the luncheon preceding the opening ceremony, which was held in the company's offices in Horseferry-road, Westminster, Sir David Milne-Watson, the governor, said that the site was noteworthy through being the first place in London where gas was made, 116 years ago. It was, he said, the intention of the company to carry out extensive experiments on low-temperature carbonisation and other processes, for which purposes a plant is being erected at Richmond. Sir Richard Threlfall spoke of the excellent results obtained, in the way of producing young men for scientific appointments, by the Department of Industrial and Scientific Research, while Alderman Waldron, the Mayor of Fulham, said that Mr. Frank Hodges had told him that Fulham would see the battle of the giants—gas and electricity.

BOOKS OF REFERENCE.

"Chamber of Shipping of the United Kingdom, Annual Report, 1927–1928. London: Witherby and Co.—This volume contains a mass of information concerning shipping and shipping matters. There are, first of all, lists of the members of the Chamber and of the members of its various standing committees. Then follows the annual report, which occupies some thirty pages, and after that comes a comprehensive series of statistical tables and diagrams, which deal with almost every conceivable aspect of shipping, including world tonnage, tonnage under construction, motor vessels, steamers, sailing vessels, sizes of ships, speeds, tankers, refrigerating vessels, launches, tonnage entrances and clearances, the Suez and Panama canals, British coal output and exports, bunkers, U.S.A. coal statistics, freights, tonnage laid up, &c. &c. Then there is a full report of the annual meeting of the Chamber, which was held in February last, and finally there are indexes (*a*) to the Report of the Shipowners Parliamentary Committee, (*b*) to the subjects dealt with in the Report of the Council, and (*c*) to the speeches made at the annual meeting.

BOOKS RECEIVED.

Car Maintenance and Repair. By A. W. Judge. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 4s. net.

Technisches Hilfsbuch. Seventh edition. Compiled by Schuchardt and Schütte A.-G. Berlin: Julius Springer, Linkstrass 23, W. 9. Price 8 marks.

Ministry of Public Works, Egypt, Physical Department: Meteorological Report for the Year 1922. Cairo: The Government Press. 1928. Price £T40.

Handbook of Mechanical Refrigeration. By H. J. Macintire. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 37s. 6d. net.

Impurities in Metals: Their Influence on Structure and Properties. By Colin J. Smithells. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 18s. net.

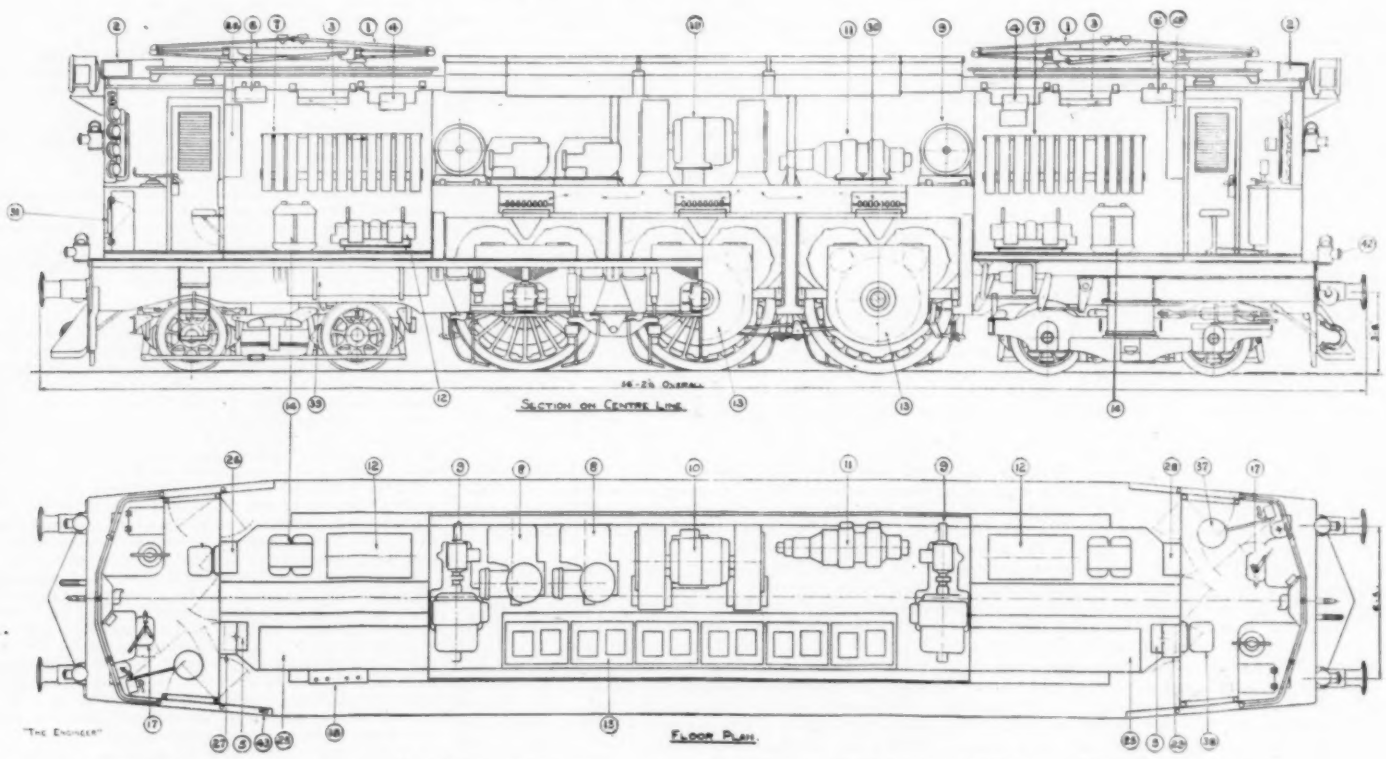
Express Passenger Electric Locomotive for the G.I.P. Railway.

The Great Indian Peninsula Railway is at present engaged on a comprehensive scheme of main line electrification covering the lines from Bombay to Igatpuri and Bombay to Poona, both of which pass over the Ghats, where very heavy gradients are encountered. Approximately midway on the run between Kalyan and Poona there is the Bhore Ghat, which is practically 15 miles in length and has a maximum gradient of 1 in 37·8, while on the run from Kalyan to Igatpuri, adjacent to the latter station, there is the Thull Ghat, which is approximately 8 miles in length and has a maximum gradient of 1 in 37.

The existing suburban electrification scheme on this railway extends from Bombay to Kalyan and, with the main line extensions, will cover a length of approximately 300 track miles, Igatpuri being 85 miles and Poona 119 miles from Bombay. Power for working the line is generated as three-phase current at a normal periodicity of 50 cycles and transmitted to sub-stations distributed along the line, where the energy is converted to direct current and delivered to overhead contact wires from which the locomotives take the power at an average pressure of 1400 volts.

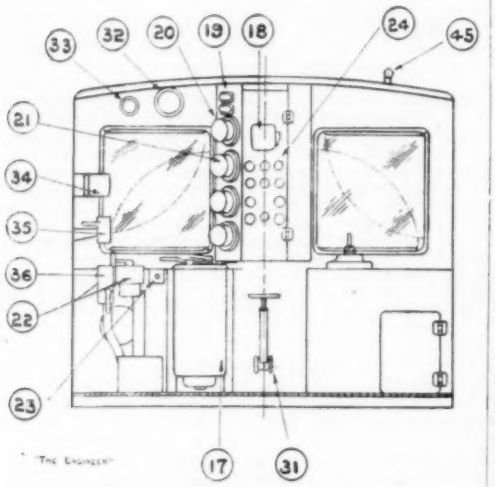
The suburban service is operated by motor coaches, but the main line service is to be operated by electric locomotives, and for the express passenger trains an order was given some little while ago to the General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C. 2, and Witton, Birmingham, for a high-speed electric locomotive. This locomotive has recently been completed, the mechanical portion of the locomotive having been made by R. and W. Hawthorn, Leslie and Co., Ltd., at Newcastle, as sub-contractors, and it has been built to the specification of Messrs. Merz and Partners, of 32, Victoria-street, London, S.W., the consulting engineers for the complete scheme, who have supervised the whole of the work.

The locomotive, which is illustrated herewith, is of the 2–A–A–A–2 type, having three main driving axles arranged for individual drive and a guiding bogie at each end of the locomotive. Each main axle is driven by a twin armature motor through a flexible gear wheel secured to a quill surrounding the axle. The torque from the quill to the axle is transmitted by means of a flexible drive mechanism, which permits relative motion between the axis of the axle and the axis of the quill, thereby allowing the motor to be mounted rigidly in the locomotive frame so that the unsprung weight and, hence, the wear on the track are reduced to a minimum. The two pinions at the end of the motor frame engage directly with the flexible gear wheel, the centre of which is rigidly secured to the quill.



1 Pantograph.
2 Main Fuse.
3 Main Isolating Link.
4 Main Choke Coil.
5 Main Earth Switch.
6 Auxiliary Choke Coil.
7 Main Contactors.
8 Compressor.
9 Exhauster.
10 Blower.
11 Motor Generator Set.
12 Reverser
13 Main Motor (twin armature).
14 Inductive Shunt.
15 Main Resistance.
16 Multi-point Cut-out Switch.
17 Master Controller.
18 Control Switch.
19 Blower and M.G. Set Indicators.
20 Voltmeter.
21 Ammeters.
22 Pantograph Switch.
23 Push Button for No-volt Relay.
24 Lighting and Auxiliary Switches.
25 Auxiliary Fuses Contactors and Resistances.
26 Overload and Blower Relays; Lighting Switch, &c.
27 No-volt Relay; Cut-out Switches.
28 Lighting Switch; Lighting and Control Fuses.
29 Overload Relay; Battery Gear.
30 Motor Connection Box.
31 Pantograph Hand Pump.
32 Vacuum Gauge.
33 Pressure Gauge.
34 Speed Indicator.
35 Driver's Brake Valve.
36 Vacuum Valve.
37 Driver's Seat.
38 Attendant's Seat.
39 Main Reservoir.
40 Headlight.
41 Marker Light.
42 Oil Riding Lights.
43 Collapsible Roof Ladder.

Elevation and Plan of Passenger Express Electric Locomotive



Section Through Driver's Cab

Main Particulars.

The following are the main particulars of the locomotive:—

Track gauge	5ft. 6in.
Total length over buffers	56ft. 2¼in.
Rigid wheel base	15ft.
Bogie wheel base	7ft.
Driving wheel diameter	6ft. 2in.
Bogie wheel diameter	3ft.
Overall width over platform	10ft.
H.P. at hourly rating	2250 B.H.P.
Speed at hourly rating	36 m.p.h.
H.P. at continuous rating	2130 B.H.P.
Speed at continuous rating	37 m.p.h.
Normal maximum running speed	75 m.p.h.
Total weight of locomotive	108 tons

The track gauge is 5ft. 6in., the running tracks consisting of B.S.B.H. rail weighing 100 lb. per yard, the maximum permissible axle load being 20 tons. The radius of the minimum curve is 500ft. and the maximum permissible rigid wheel base 16ft.

Severe limitations are imposed by the climatic conditions, not only in respect of high atmospheric temperature, but also owing to the fact that, during the monsoon season, parts of the track are liable to be flooded to a depth of 2ft. 9in. above rail level, and it is essential that the locomotive should be capable of passing through such a flood without seriously impairing its operation. The specified conditions of output provided that, at a line pressure of 1400 volts, the locomotive should exert a tractive effort of 24,000 lb. up to a speed of 36 m.p.h. and a tractive effort of 6300 lb. at 70 m.p.h.

Although the normal running speed does not exceed 75 m.p.h., the locomotive had to be designed for a maximum speed of 85 m.p.h., and as it has to operate in conjunction with goods locomotives on the Ghat sections, it was also required to exert a tractive effort of approximately 16,000 lb. at 26 m.p.h. at 1400 volts. It was further specified that the locomotive should start, from rest, a train weighing 450 tons on an up gradient of 1 in 100 and attain a speed of 36 m.p.h. at 1400 volts, and repeat that operation ten times at five-minute intervals without the temperature of the main resistances exceeding 250 deg. Cent. Under these starting conditions the tractive effort was not to vary by more than 10 per cent. above or below the mean value.

Mechanical Portion.

The mechanical portion of the engine follows generally standard British and Indian steam locomotive practice, in many cases parts that are interchangeable with existing standards on the Great Indian Peninsula Railway having been adopted. There is a driving cab at each end, the driving positions being on the left-hand side of each cab. Front and side lights are provided, the side drop light being arranged for operation by the driver when seated, to facilitate shunting operations. The train is fitted with vacuum brakes, but the locomotive itself is separately equipped with air brakes. Accordingly, there are two compressors and two exhausters, both electrically driven, the exhausters being arranged for operating the train brakes and the compressors for operating the locomotive brakes. Special valves are used to obtain, automatically, proportional action of both train and locomotive brakes by a single manipulation of the driver's vacuum brake handle. Both sides of each driving and bogie wheel are braked and sanding of the driving wheels is provided for both directions of motion.

Individual Axle Flexible Drive.

The drive used on this locomotive has been specially developed for high-speed locomotive work by the General Electric Company, Ltd., in conjunction with its associates, Les Ateliers de Construction Oerlikon. The drive, which is known as the "yoke" drive, was constructed for the G.E.C. by Hawthorn, Leslie and Co., and for it it is claimed that, with any possible relative movement of the axle and quill, the mechanical transmission is almost perfect in operation. The main motors are supported on the main frames and each armature has a pinion meshing with a common gear wheel mounted on the quill. The quill itself is carried in bearings housed in the motor frame, so that accurate meshing of the teeth and constancy of the gear centres are maintained. The gear wheel is of the flexible type, to ensure uniform transmission of the torque.

The flexible drive mechanism is mounted at the opposite end of the motor frame from the gear wheel and is coupled to heavy pins on the driving wheel. The torque is accordingly transmitted from the motor pinions, through the gear wheel to the quill, thence through the flexible "yoke" drive to the adjacent driving wheel and subsequently through the axle to the other driving wheel of the pair on that axle.

The principle of the drive is illustrated in the half-tone engraving. The torque from the quill passes to the drive frame, which is arranged to enclose the link mechanism. The torque then passes through sliding block A and sliding block B to the forked framework *via* connecting bolts C. The driving link D is pinned at E and F, the former being connected to the forked frame and the end F being connected to pins on the driving wheel. The connecting links are provided with spherical bearings in order to allow the angular movement between the road wheels and the drive. The drive therefore transmits the torque with varying excentricities between the centre line of the axle and the centre line of the quill without rapid acceleration or deceleration of the armature masses.

The makers point out that this drive embodies the following important features:—(*a*) There are no spring members, rigid coupling links only being used, so that the breakages so common in spring drive mechanisms are avoided; (*b*) springs are used in the flexible driving mechanisms to absorb the stresses arising from the imperfection of the drive; (*c*) the absence of springs in the "yoke" drive follows from the avoidance of such stresses owing to inherent accuracy of the principle employed; (*d*) the drive facilitates the use of double-armatured motors and complete enclosure of the gearing, thereby ensuring protection from dust and obviating loss of lubricant; (*e*) the gear wheel on the quill is not stressed by the presence of coupling pins attached to the wheel itself, so that any tendency to deform the gear is avoided and perfect meshing is thus obtained; and (*f*) the drive is simple in construction, in that the mechanism requires only four universal joints and two sliding blocks.

The lubrication of the drive is automatic, being effected by two ball valve pumps operated by the motion of the drive frame, and these pumps pick oil up from the periphery of the drive frame. The oil is whirled outwards by centrifugal force. From the pumps the oil is fed by flexible pipes to all points requiring lubrication. Covers are provided to permit inspection of the drive mechanism, links and lubricating arrangements, and the drive may readily be dismantled by lowering the complete wheel set, with the motor, into a pit and subsequently removing the motor from the quill.

Lay-out.

The general arrangement of the locomotive and the lay-out of the equipment is illustrated in the accompanying drawings.

The body is of the box type with drivers' compartments at each end, the latter having entrance doors furnished with drop lights on either side.

The electrical and air and vacuum brake gauges are arranged so that they can be readily observed by the driver without interfering with his look-out. There are two through corridors, one along each side of the locomotive connecting the two driving compartments. These gangways also give access for the inspection of the main motors and auxiliary machines. The central portion of the locomotive forms the machinery compartment. The space immediately above the traction motors is occupied by the main starting resistances and the auxiliary machinery, the latter comprising two electrically-operated compressors, two electrically-operated rotary exhausters, a motor-driven double blower and the auxiliary motor generator set. Intermediate between the central machinery compartment and the driver's compartments, are the high-tension compartments, two in number. Each has a gangway along the centre line of the locomotive separated from the driver's compartments by doors interlocked with the high-tension circuits to ensure that all apparatus is dead before access can be gained to either high-tension compartment. In the high-tension compartments are arranged the main contactors, main motor reverser, inductive field shunts and auxiliary high-tension control apparatus. The arrangement has been chosen to obtain uniform distribution of the weight and, at the same time, to make the control gear readily accessible, both back and front. Particular attention has been given to rendering the control gear accessible from the interior of the high-tension compartment, as far as possible, by such features as the fixing of the contactor interlocks on the front of the contactors, &c.

Reservoirs for lubricant for the driving axle-boxes are arranged on the upper part of the main frame inside the locomotive, so that the supply of lubricant may, if necessary, be replenished or inspected while the locomotive is in operation.

Main Motors.

The main motors are of the forced ventilated twin-armature type, it being considered that with such armatures a better mechanical arrangement, than if single-armature motors were used, is possible. Furthermore, as two commutators are always in series across the line, the electrical stability of the motor is considerably improved, since it is possible to adopt a moderate value for the voltage between commutator segments. Each motor is rated at 710 brake horse-power and 750 brake horse-power, respectively, on the continuous and one-hour ratings at the average line voltage of 1400 volts, based on the British Standard Specification No. 173 of 1923 for the electrical performance of traction motors.

Single-sided driving only is used, a pinion at one end of each armature shaft gearing with a common gear wheel secured to the quill. The gear ratio is 1 to 4·5, and the gear wheel is of the flexible type. The main motor frame is of box construction and is of high permeability cast steel. It is provided with openings for inspecting the interior of the machine.

The motors are of the four-pole type, the main poles being arranged on the vertical and horizontal axes, with interpoles at 45 deg. This arrangement, it is pointed out, has advantages in obtaining uniform temperature rise on the field coils, since it enables better proportioning of coil area for the dissipation of the heat generated. The armature laminations are pressed together between cast iron end bells and are keyed to a cast steel spider, this arrangement permitting of the removal of the armature shaft without disturbing the winding or commutator. Mica is used for insulating both armature and field coils almost entirely. The armature bearings are arranged for ring lubrication, experience having indicated that that method is preferable to the oil and waste method at the high armature speeds involved. Particular attention has, however, been given in the design of the bearing housings to prevent oil from the bearings gaining access to the interior of the motors. The main quill bearings are lubricated by the oil and wool waste method.

The motor is provided with forced axial ventilation of the parallel flow type, air from the motor-driven blower being conducted to the commutator end of the motor, where it divides into four streams, two streams passing respectively over the surface of each of the two armatures and their respective field coils, and the other streams passing through tunnels formed in the cores of the armatures. The warm air is exhausted from the motor at the pinion end and is thence conducted to the main resistances, being finally ejected through louvres in the roof clerestory.

Control System.

The control system is of the electro-pneumatic type, separate unit switches being used for the line switches, resistance switches and combination switches. The direction of running is changed by means of a drum type reverser, which also operates as the motor cut-out switch. The drum type reversers are also electro-pneumatically operated. No cam type switch units are employed. The electro-pneumatic contactor system was adopted as it is considered the most satisfactory for heavy locomotive work, but it was only chosen after most careful investigation of other systems, such as the "all-electric" unit switch system and the various forms of cam shaft method. One particular feature of the electro-pneumatic unit switch is that very high opening forces for the contactor can be provided, which obviates the danger of contactors "freezing in."

The control system is arranged to give series, series-parallel and parallel connection of the main motor armatures, corresponding respectively to six armatures in series, two parallel groups of three armatures in series, and three parallel groups of two armatures in series. Resistance steps are provided in each motor grouping, there being thirteen series notches, ten series-parallel notches and ten parallel notches, this arrangement being adopted to ensure even starting. In addition, there are two weak field notches, which can be used in any one of the three motor groupings, thus further enhancing the flexibility of the control by making it possible to use any of nine economic running speeds without having any main resistance in circuit.

The method of field control used is field shunting, inductive shunts being used for the purpose. This method is considered by the makers to be preferable to field tapping, since the latter has some tendency to cause flash-over of the motors. In designing the field shunting equipment, the resistance and inductance of the shunts were proportioned to give the same time constant as the main motor fields, thereby ensuring that the current builds up simultaneously in the two parallel circuits and the possibility of any flash-over is minimised. Overload protection is provided by main fuses, one immediately in front of each of the two pantographs—which are of the air-operated, double-pan type—and by duplicated line switches in conjunction with overload relays in each of the three motor group circuits. A choke coil is used in conjunction with each pantograph circuit, and an aluminium type arrester is employed for protection from lightning and surges. Each pantograph has an isolating switch, which is capable of operation by a hooked stick. In addition, there is a pantograph bussing switch so that with either pantograph cut out, current may be fed to either or both main motor circuits.

The main earthing switches are interlocked with the high-tension doors, and there are arrangements for the isolation of any particular motor. In addition, the whole equipment is divided into two halves and, by means of multi-point switches, either of the halves can be quickly put out of operation without the need for entering either high-tension chamber. This duplication is also carried out as far as possible on the auxiliary and all control circuits. Two separate feeds to the auxiliary circuits are therefore provided, these feeds being taken from the negative side of the main earthing switches and being separately protected by auxiliary fuses and auxiliary choke coils. Furthermore, each individual auxiliary motor circuit is protected by a 1500-volt fuse, all circuits being controlled by 1500-volt electromagnetic contactors under remote control.

The two 1500-volt exhauster motors are arranged for two-speed control by means of a contactor which short-circuits a section of the motor field and a small series resistance. This contactor is energised by contacts on the driver's brake valve, so that, during normal running, the exhausters run at normal speed in order to maintain the vacuum in the train pipe line, but that, when the brake is operated, the exhausters are run at high speed to re-create the vacuum. The 1500-volt compressor motors are switched direct on to the 1500-volt line. The blower motor is provided with two starting steps, a large resistance being inserted in the circuit at the initial step, this resistance being partially cut out automatically as the set runs up to speed by means of a time lag relay.

The motor generator is of a special type, the unit comprising motor, generator, and a small exciter. The windings on these three machines are so arranged that, with widely fluctuating conditions on the high-tension side, the voltage on the low-tension side is approximately constant. Thus, with a load of 35·5 ampères on the low-tension side there is no appreciable variation in the low-tension voltage when the line voltage varies suddenly from 1900 to 700 volts.

A battery is arranged to float across the generator. It is controlled by the usual cut-in and cut-out switch, the nominal voltage of the auxiliary circuits being 50 volts.

Brake System.

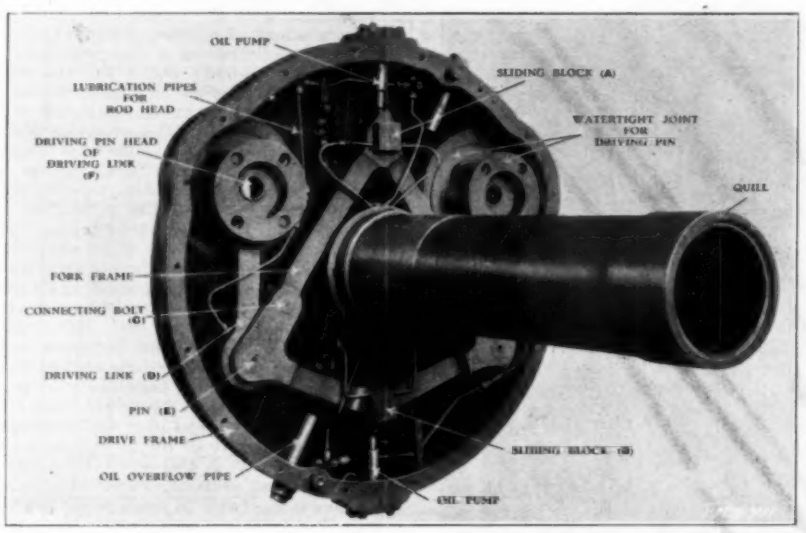
As previously stated, the locomotive is provided with both electrically operated compressors and exhausters, the train brake being of the vacuum type, and the locomotive brake of the compressed air type. Each driver's compartment is furnished with a driver's vacuum brake valve, which is that normally used, and, when operated, actuates not only the train vacuum brakes, but, by means of a special diaphragm type of valve, the air brakes on the locomotive, the release in both cases being proportional.

Furthermore, a straight air application valve is fitted on the locomotive for applying the air brake on the locomotive only, should that application be required. Arrangements are also made for the locomotive brakes to be locked off while a brake application is made on the train. This feature enables the driver to make smooth service stops, especially when hauling long trains.

Control and Auxiliary Apparatus.

The admission of air to the contactor operating cylinder is controlled by an electro-pneumatic valve, the travel or the piston being guided and the lower contact jaw being provided with a knuckling spring to ensure a wiping action to the contacts in opening and closing. Furthermore, those parts of the jaws normally in contact, viz., the heels, are not those at which the arc is extinguished, as the tips are last in contact in opening and all pitting, therefore, is confined to them. The contactor is equipped with a magnetic blow-out. In tests conducted on this type of contactor a current of 3800 ampères at 1500 volts was, we understand, broken for a number of successive movements without damaging the contactor in any way. The main motor reverser is provided with handles for manual operation of the reverser drums to a position intermediate between forward and reverse, in which the corresponding motors can be isolated when desired. A twin bakelite insulated bar construction has been adopted for supporting the contacts.

The master controller is provided with the handles for controlling the various resistance notches, the grouping of the motors, and forward or reverse running respectively. The main drums are interlocked with the reverser drum in such a way that the main drums cannot be moved unless the reverser is fully thrown into either the forward or reverse position. Furthermore, the reverse drum cannot be operated unless the drums are in the "off" position. The main and motor grouping handles are fixed, but the reverser handle is removable, a shroud being provided on the cap plate to ensure that the reverser handle can only be removed in the "off" position. Thus the reverser handle controls the operation of the whole of the controller and unauthorised operation is rendered impossible.



ARRANGEMENT OF QUILL DRIVE

Research in British Timber.

Simultaneously with the announcement by the Government that the grant from the Treasury for afforestation should be increased from three and a-half millions per ten years to five and a-half millions for the next ten years, the Earl of Balfour, on July 31st, welcomed a number of interested guests at the Forest Products Research Laboratory of the Department of Scientific and Industrial Research at Princes Risborough, Buckinghamshire. Although not directly concerned with the afforestation of the waste land, the Laboratory will, of course, prove of great assistance in our emancipation from dependence on some classes of foreign timber and help towards the more extensive utilisation of those trees, such as the English oak, than which none others are better in the world.

and which provided one of the most important structural materials a few hundred years ago. The afforestation grant provides the means for planting out the land, and the Laboratory will not only indicate the best classes of trees to plant, but will also, it is hoped, lead manufacturers to pay more attention to home-grown timber and to find new uses for it. There is, we suggest, yet a further service which the Laboratory may give, and that is the more economical preparation of such timber as we may import. There is, for instance, the seasoning of deals, which is now mostly carried out in great stacks at the docks which occupy much valuable space. It would seem that the investigations at the Laboratory into the kiln drying of timber might be extended to cover this phase in the preparation of wood and that a great saving in space and time might be effected thereby.

The site of the Forest Products Research Laboratory is quite close to the Princes Risborough Station of the Great Western Railway, with which it is connected by a private siding. The arrangement may be divided up into three distinct sections. First, on approach from the railway, there is the sawmill, with a log pond and timber yard. Then there come the experimental buildings and finally the administration offices, which, by the way, are situated in charming wooded surroundings. The offices have been so built that they may be readily extended, and we heard that already the necessity for extension is foreshadowed.

Before going on to describe the equipment it may be as well to point out that all the machinery is electrically driven, with the exception of a few pumps, and that the electricity supply is taken from the public mains as high-tension three-phese current. This is transformed down and is supplied to some of the larger motors, such as those in the sawmill, as alternating current, while motor generators supply direct current for those services in which a variable speed is required. Steam for heating is generated in a return-tube boiler.

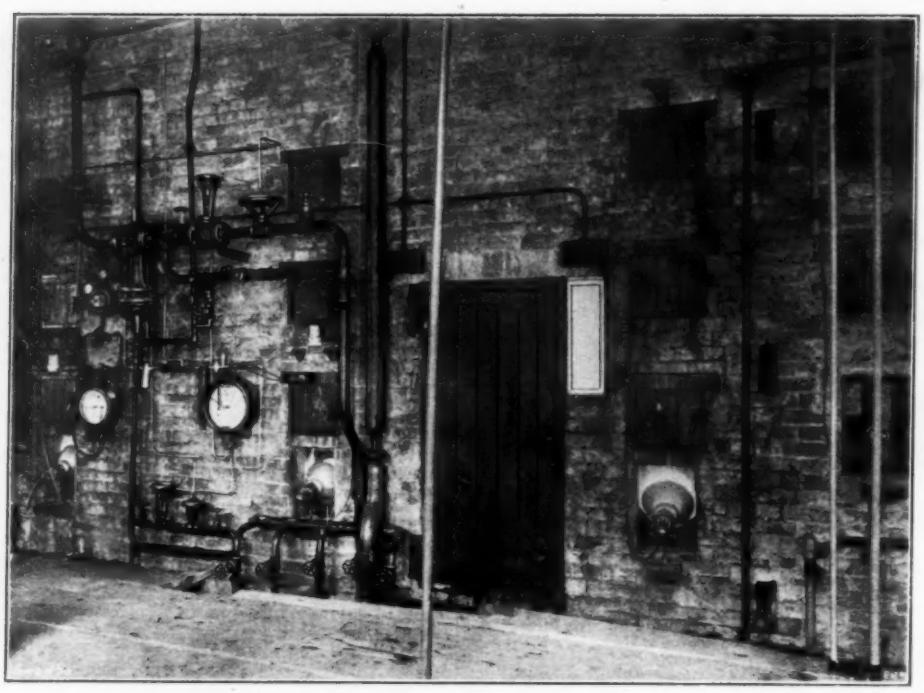
Reverting to the sawmill, the building is an open-sided, steel-framed shed, close alongside the railway siding, from which logs can be unloaded by a hand-operated overhead gantry. This gantry also extends over the concrete log pond in which logs can be stored. At present the water in this pond is stagnant, but arrangements are being made for its periodical refreshment. In the mill there are a high-speed horizontal frame saw, a band saw and circular saws, with which the logs are converted into useful scantlings. Each of the machines has its individual drive. The converted timber is taken to a large brick-built store, from which it is drawn as required.

In this section we noticed a rather interesting trial going forward. It had been suggested that when oak is piled in high stacks the weight of the mass tended to prevent the lower tiers from warping, but that checking of the wood might be encouraged. So a pile of boards had been made up and was heavily weighted through a system of levers. Close alongside there was another pile stacked in the usual manner. On the occasion of our visit it was too early to decide the result of the test.

The next building to the store is a woodworking shop equipped much in the manner of a commercial joinery, except, perhaps, that there is more unoccupied floor space than is generally usual in a commercial undertaking. In this shop wood is worked up in various practical ways by skilled artizans to determine the machining and finishing qualities which have been imparted to it by its previous treatment in seasoning and so forth.

Following along the same line of buildings one comes next to the saw repair shop, where the saws and cutters used in the mill and workshop are kept in order, and anyone interested is welcome to study the processes there carried out.

One of the largest separate laboratories comes next in the itinerary and is devoted to the testing of the mechanical strength of wood. A view of part of its interior is reproduced on page 120. This room is equipped with a large number of testing machines, and we were impressed with the fact that those machines are set aside, more or less definitely, for testing some individual characteristic of the specimens. Thus, for instance, it is a comparatively simple matter to "rig" one testing machine to carry out tensile, compressive and bending experiments, while shear tests require little additional apparatus. In this laboratory, however, the experimenters are in the fortunate position of being able to go directly to a machine which is especially adapted to the test desired. There are, of course, some tests which require a specially designed machine, and that of resistance to impact might be mentioned as an instance. In the machine used for this purpose a beam of the wood is subjected to the blows of a falling weight, released electromagnetically, and a pencil following the weight records, not only the fall of the weight, but also the deflection of the specimen from the normal. The weight naturally rebounds from the first blow and its movements are recorded until it comes to rest. As the test proceeds the height of fall is increased until the specimen fails.



CONTROL ARRANGEMENTS OF EXPERIMENTAL WOOD DRYING KILNS

In this connection we learned authoritatively that wood behaves very much like other materials of the engineer, and that if the elastic limit is not exceeded in the stress imposed by the blow, that blow can be repeated almost indefinitely without failure. Nevertheless we did not notice any fatigue testing appliances in the laboratory. A more or less related characteristic of wood is that if it is stressed beyond the elastic limit, especially by a static load, it does not recover from deformation. In other words, by such treatment the bond between the fibres of the wood is broken, they slip over one another, and then adhere together again to maintain the new shape to which the wood has been deformed. Tests for such purposes can be carried out on joists up to 12ft. span and with loads up to about 10 tons. The elaboration in the equipment may be gauged by the fact that there are several machines for compressive tests; for determining the strength in shear of wood along the grain, such as in a "halved" or spliced joint; for the shearing effect of round bolts used for fastenings, and for the indentation of locally applied loads. In all these machines the load is applied by an individual electric motor, and its magnitude, in the case of static machines, is measured by a steelyard.

Adjacent to the mechanical testing department there is a room where the moisture content of timber can be tested. It is equipped with electrically-heated boxes, in which a temperature of from 95 deg. to 100 deg. Cent. is maintained, and balances are provided for weighing the specimens before and after treatment. Upstairs there is a room in which there are displayed a number of specimens indicating the effect of various systems of drying.

Now, having passed down one side of the central alleyway, which incidentally is served throughout its length by the railway siding, we will cross over and work back in the opposite direction.

The first buildings are the boiler-house and electric station, but they need no further comment. Next there comes a set of typical drying kilns. There are, at present, five separate kilns, each of which is equipped with a different system of air circulation and heating. There are, for instance, kilns with natural draught, others with fans, both interior and exterior, and another in which the draught is induced by sprays of water. Again the humidity of the atmosphere, which is necessary to prevent the too rapid evaporation of the moisture near the surface of the timber, and allow for the expulsion of the more remote water, is supplied in various ways, by means of steam jets and water sprays. All these kilns are substantially built structures, and are large enough to carry out tests on a commercial scale. The fronts of some of them are shown in the engraving above, which also indicates some of the apparatus for controlling and measuring the conditions of drying. Our guide during this part of our tour was most emphatic on the degree of skill necessary in attending a kiln if satisfactory results are to be obtained, and we can quite appreciate that a visit to the laboratory by any one contemplating the installation of a kiln would be well repaid. There is also, in this department, an experimental kiln, on a more modest scale, which is very adaptable in its working conditions, for investigations on the drying of less familiar timbers.

More or less associated with the kiln department there is the section devoted to natural seasoning, and there tests are carried out on the effect of various programmes, such as storage in the pond as logs, in the open as logs, in the open after sawing, and a great number of combinations of the several processes.

The preservation of timber from decay can be investigated by means of an impregnating plant capable of accommodating, for instance, a bundle of pit props, or, with the help of a portable extension to the treating chamber, a charge of double that length. The chamber is equipped with tanks for the storage of liquids for treating the timber, together with steam-driven pumps for producing a vacuum or forcing in the liquid. There is a weighbridge for weighing the charge of wood as it goes in and out of the treating chamber, and means for determining the pressure and quantities of the liquids used. Just prior to our visit a bunch of pit props had been treated by the vacuum-pressure process, with zinc chloride, and before that some soft wood had been impregnated with Wolman salts. These salts are largely a mixture of sodium fluoride and bichromate of potash, and naturally give the timber a yellow tinge. Nevertheless paint will take well over the treatment, and it does not appear to hurt the wood from a mechanical point of view. It is also noteworthy that the salts penetrate to an unusual extent into the sap wood, and those rings of growth which have matured rapidly. There were some interesting examples, in this department, of the proper and the careless impregnation of timber with preservatives. For instance, samples of weather-boarding showed that as much as 35 lb. of creosote could be forced into a cubic foot of wood—that is to say, its weight might almost be doubled—with obvious preservative effect, while a railway sleeper in which the penetration of the preservative was, say, ½in., was so rotten that it could be pulled apart by the fingers.

The machine-shop and forge are what might be described as service departments, and do not require much comment, but are nevertheless noteworthy through being so thoroughly equipped that the establishment requires little outside assistance. In fact, the whole "air" of the place is that it is self-contained, and that if any unusual problem arises there is the equipment necessary for its investigation on the spot. The same principle applies to such details as photography and the preparation of graphs and drawings to illustrate reports.

In such an establishment it is only natural that there must be produced a considerable amount of scrap, but it is not merely burned under the boiler. Within the grounds there is an enclosure where there is accommodation for the testing of charcoal-making plant. Just now there are three typical examples of the Trihan, Tattersall and Hexa types, undergoing trial. There is also a department concerned with pathology, that is to say, the fungi and insects causing decay and their eradication, and another dealing with the anatomical features of wood, which co-operate with the Imperial Forestry Institute, Oxford.

As to the administrative side of the laboratory, that is scarcely our affair, but we were impressed by the pains taken in the offices to collect and collate every scrap of information bearing on the activities of the institution. The laboratories have cost the country some £80,000, but that may be quickly recouped if only some of our waste land can be turned to the production of useful timber.

On page 120 we give views in the mechanical testing department, showing principally the machines for bending, shearing and impact tests; and the impregnating plant for preserving wood. In the latter view it will be noticed the chamber has been opened for the withdrawal of a completed charge.

A New Exhibition Hall at Leipzig.

IN an article on the 1928 Technical Fair at Leipzig, which appeared in THE ENGINEER of March 16th last, we made brief reference to the No. 7 Hall for commercial motor vehicles, which was rebuilt and completed shortly before the Fair opened. The new building was an object of interest to many visitors, chiefly on account of the novelty of its structural design, giving a well-lighted floor space entirely free of pillars. The area of the exhibition space is about 154,000 square feet, which, it is claimed, is covered by the largest single-span roof in any exhibition hall in the world.

By the courtesy of the constructors of the building, the Gustavsburg Works of the Maschinenfabrik-Augsburg-Nürnberg A.G. (M.A.N.), and our contemporary German technical journal, *Der Stahlbau*, of Berlin, which, in its issue of April 6th last devoted a special article to this hall, we are now able to publish further details of its design and construction, and to give some particulars of the way in which it was erected.

The contract was let on October 31st, 1927, and erection was begun early in January this year. It is worthy of note that in seven weeks over 1800 tons of steelwork were assembled and erected, so that the completed building was ready for use in three and a half months after the placing of the order.

The accompanying engravings—Figs. 3 and 5—show a view of the present entrance and the outside of the new hall, and an interior view, which gives a good idea of the large and clear floor space, and the effective lighting from the roof. As will be noted from the interior view, there is a raised terrace along the front entrance of the building. It is 1·5 m. high and about 4 m. broad, and a centre flight of steps and two similar series of steps on each side of the hall lead down to the exhibition floor level. The outstanding feature of the design is, undoubtedly the novel way in which the large, flat, single span roof with its intermediate glazed panels is supported by transverse portals in such a way that the girder work is scarcely perceptible when looked at from the floor of the building.

The hall has an inside length of 138·6 m., or about 455ft., and is 97·8 m., or a little over 320ft., broad, with a height from the floor to the underside of the roof of 21 m., or nearly 69ft. The roof load is 135 kilos. per square metre, and this, together with a snow load of 75 kilos. per square metre and a wind load of 125 kilos. per square metre, is carried by seven portals, comprising two braced columns and a continuous roof girder, each of which has a span of nearly 100 m. The girders are placed transversely at 19·5 m. intervals, and their arrangement is clearly shown in the part plan and elevation, Fig. 1, and the view of one of the portals and the gable end of the building reproduced in Fig. 2. In both these last-mentioned drawings the principal roof members are indicated by heavier lines.

Attention may be directed to the constructional and architectural importance of the roof lights, which comprise about 40 per cent. of the roof area, and the way in which they are grouped around the main roof girders. The columns supporting these girders, with their cross bracings, are shown to the left hand of Fig. 6. It may be noted that the heaviest members are composed of No. 30 Continental standard channels, and that at the foot of each column there is a simple foundation plate with anchors, consisting of 23 mm. and 30 mm. diameter rods at the inside and outside respectively, bent into loop form. The horizontal girders have a depth of 8·5 m., and the width of the vertical supporting columns is 3·5 m. The sections chosen are such that the maximum loads do not exceed 444 metric tons in tension and 488 metric tons in compression.

To the right of Fig. 6 a detail drawing of the roof lights with their supporting girders is given. The top boom, the cap of which forms the roof ridge, is 5·5 m. above the plane of the roof, while the bottom boom is 3·0 m. below the plane of the roof and projects within the building. This form of construction has enabled the designers to give adequate stiffness to the roof and to use continuous purlins, which are only supported at 19·5 m. intervals, and, nevertheless, are only subjected to an additional stress of 410 kilos. per square metre at the point of maximum loading. The outer lights are composed of wired-glass panels, which are carried on beaded glazing bars, so that no putty joint is required. The joints between the internal lights are made with putty, the 7·5 m. broad panels being carried by glazing bars placed at 730 mm. intervals. It will be seen that the girder work is thus totally enclosed by the glass lights, and it is therefore protected against rust, but is easily accessible for inspection. No sweating has been found to take place in the inner surfaces of the lights, on account of the good circulation of air in the space between the upper and the lower lights. Fig. 5 shows the excellent effect which is produced by the broad V-shaped lights depending from the roof. The drawings we reproduce clearly indicate the type of girders and cross bracing which has been employed. The standard numbers of the angles refer to the German standard sections, and in order to render comparison with English sections more easily to be made, we have given the principal dimensions in millimetres.

The material used for the No. 30 sections was the special No. 48 high-tensile steel, whilst the standard No. 37 steel was employed for all other sections. Between the sky lights, the flat roof, which has a slight incline towards the gutters at the foot of the upper lights, is carried on steel rafters placed at 8·0 m. intervals, with small transverse supports, 1·9 m. apart. The gutters already referred to are sloped from the centre of the roof to the side walls, so that the rain water is easily discharged from the roof.

The roof is covered with slabs of artificial stone, which are made from a "trass" concrete.

As will be seen from the front view of the building, Fig. 3, and the interior view, Fig. 5, the upper part of the wall at the sides and ends of the hall is formed of light double concrete slabs of the special type above referred to. At the gable ends the weight of the upper part of the wall

FIG. 3—OUTSIDE VIEW OF THE NEW HALL

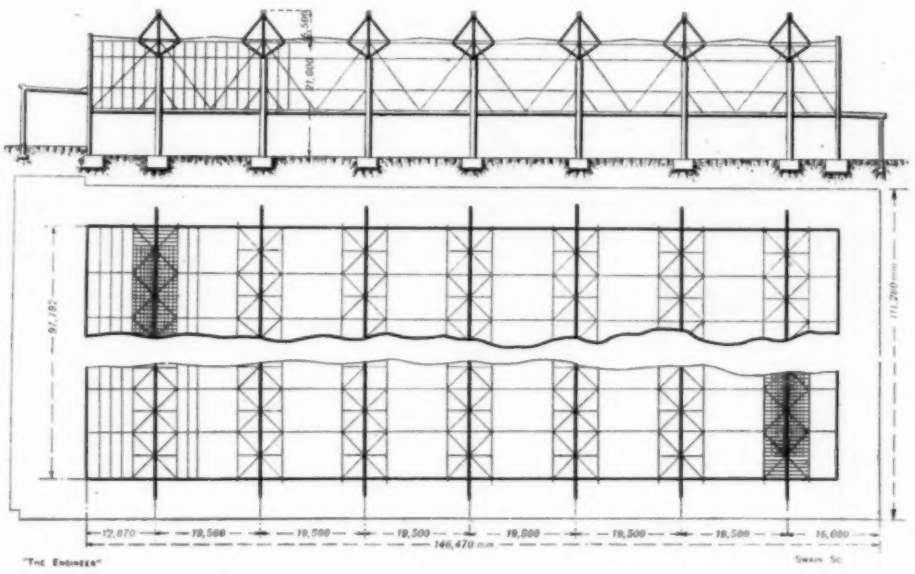


FIG. 1—ELEVATION AND PLAN OF THE NEW BUILDING

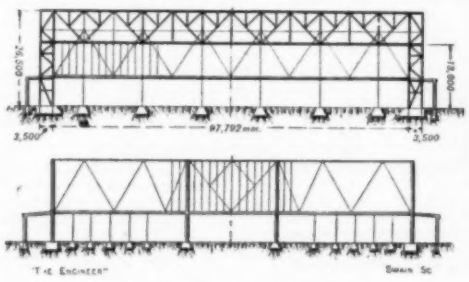


FIG. 2—SECTION AND END

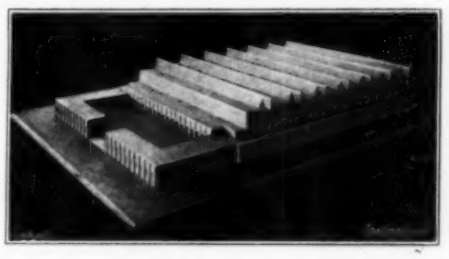


FIG. 4—MODEL OF HALL WHEN COMPLETED

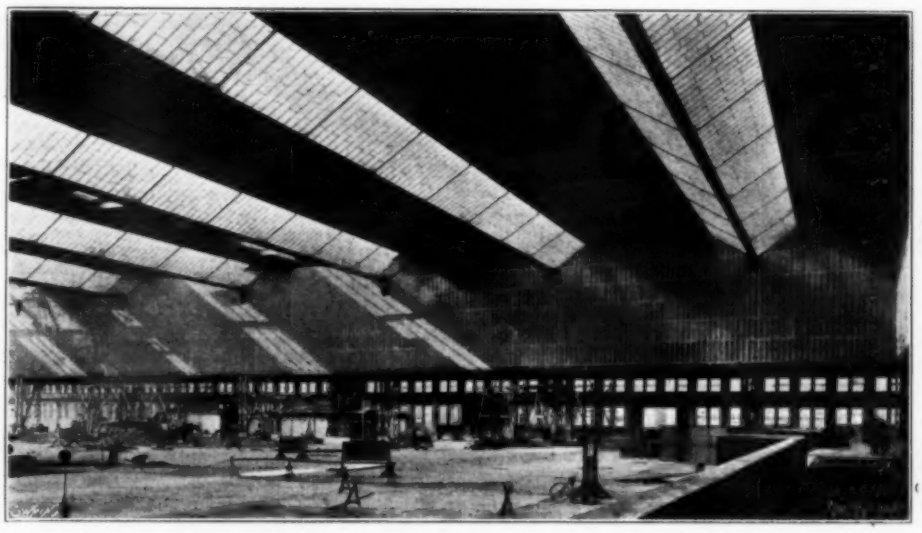


FIG. 5—INTERIOR VIEW LOOKING FROM THE RAISED TERRACE

is taken by the supporting girders and diagonal bracing shown in the lower view of Fig. 2. The front gable wall is joined to the entrance hall belonging to the old wooden building which preceded the present structure, and at a later date this will be reconstructed to conform more closely with the style of the new building, as shown in the model illustrated in Fig. 4. When completed, this will take the form of an entrance arcade, which will afford considerably extended restaurant facilities.

Attention may be called to the covered ends of the seven portals which project outside the building, as shown on the left hand of Fig. 3. They may not, it is true, present a very pleasing appearance, but any deficiency in that respect is more than compensated for by the important part which they play in the structure of the building. As this view shows, the sides of the building are built out to form annexes with the walls between each supporting column. This additional space at the sides of the building forms another architectural feature of the hall, and it constitutes a valuable asset for exhibition purposes. At the back of the building an annexe serves to house the heating installation, to which brief reference may be made. The hall is heated by warm air to about 60 deg. For this purpose a high-pressure steam boiler plant, with air-heating equipment and oil filters, are provided. The large hall requires 3,400,000 calories per hour, added to which 300,000 calories are required for the front building, which is often used separately for restaurant purposes. The air-heating equipment is housed in two compartments in each of the longer sides, and one compartment in each of the shorter sides. The fans in each chamber have an output of 55,000 cubic metres of heated air per hour. The air is passed through oil filters before it is heated by steam, and it is then delivered through channels beneath the floor to wall ventilator fittings, which discharge the air 6·5 m. above the floor level. These ventilating fittings are provided with grids, which can be worked from the floor level. Arrangements are also made whereby the fans can also be worked as exhaust fans to clear the air from the building when so required.

In conclusion, reference may be made to the work of erection, which was so expeditiously carried out by the M.A.N. company. As previously mentioned, the total weight of the steelwork, exclusive of the lattice work, was 1800 tons, which had to be erected within seven weeks. It was decided to build up the roof girders on the ground, by means of a movable girder assembling block, shown in the middle of Fig. 6. An erection mast, shown in the same drawing, was employed to set up the supporting columns and erect the cross bracing between them.

The roof girders were assembled in three sections, each comprising four bays. They were first lifted into position by means of an erection scaffold and portal crane illustrated in the foot of Fig. 6. This crane was fitted with two swinging jibs, which served to put into position the continuous purlins. The drawing at the right bottom corner of Fig. 6 shows the girder erecting crane working on a girder. Bay No. 1 is assembled ready for lifting into place, bay No. II. is partly lifted and bay No. III. is attached to the supporting columns. The completed girders, before riveting, were given a small initial camber by means of hydraulic jacks, in order to compensate for the weight of the roof and the working load carried by the beams.

Although the roof girders possessed a slight initial camber it was possible to secure the continuous purlins to the rafters, as the long unsupported 19·5 m. length of these rolled sections enabled them to take up their correct position when the load came on.

The number of men employed on the work was 330, of which sixty were members of the M.A.N. company's erecting staff. Two shifts were worked, one day and one night. During the night the material was assembled and riveted, and by day the erecting took place by means of the appliances we have described.

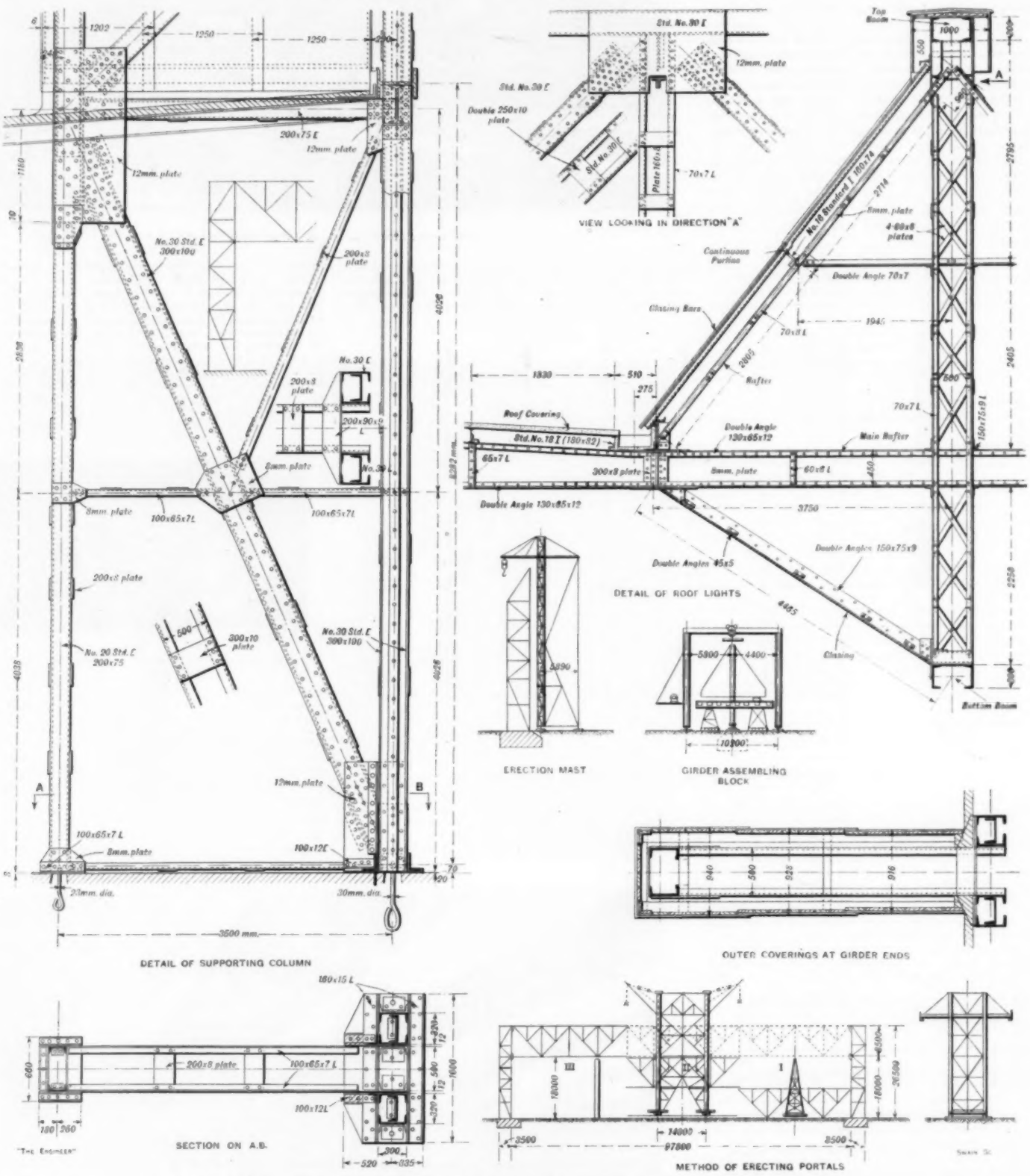


FIG. 6—DETAILS OF SUPPORTING COLUMNS, AND ROOF LIGHTS, WITH ERECTION APPLIANCES

ONE of the latest uses reported for metallic cadmium is, according to the *Industrial Bulletin* in the manufacture of tungsten electric light filaments. An alloy of 42 per cent. cadmium, 53 per cent. mercury, and 5 per cent. bismuth is impregnated with tungsten powder. The mixture is made into wire by the extrusion process, and after passing through a die is heated to drive off the alloy, and finished by heating in a vacuum to consolidate the tungsten.

Railway Matters.

THERE were 25,442 privately owned wagons registered during 1927 to run on the railways of Great Britain, as compared with 7220 in 1926 and 11,010 in 1925. Among the first quoted figure were 650 20-ton coal wagons and 721 tank wagons.

BRITISH railway companies used last year in the maintenance and renewal of the permanent way 206,737 tons of rail and 4,056,486 sleepers. Those figures represented, when compared with the year 1926, a decrease of 13,000 tons of rail and of 258,000 sleepers.

IN answer to a question on the 23rd ultimo, Colonel Ashley stated that among the amounts up to which he was prepared to incur liabilities on behalf of the Road Fund during the current financial year was a fresh sum of £250,000 for the reconstruction of weak bridges and construction of bridges in place of level crossings.

THE meetings between the railway general managers and the representatives of the three railway unions which have been discussing ways and means whereby the wages bill may be reduced, had a delightfully gratifying and quite unexpected result on Friday, July 27th. It has been agreed that a reduction of 2½ per cent. be made in all wages, salaries and directors' fees as from the 13th inst. The agreement is for twelve months, and thereafter to be terminable by three months' notice; such notice must, however be given by either side collectively.

THE annual report for 1926–27 of the Indian Railway Board said, on the question of the standardisation of locomotives, that in pursuance of its policy of progressive standardisation, the Board had arranged for designs to be prepared and orders to be placed for four experimental four-cylinder 4–6–2 broad-gauge locomotives, with a high boiler pressure. The general design of these engines would follow closely upon that of the 4–6–2 standard heavy passenger locomotive, but their boilers were to have a working pressure of 225 lb. per square inch, and be provided with cam shaft operated poppet valves, arranged to give a constant release and compression at all points of cut-off.

IN view of the railway companies now possessing road powers, the announcement of July 24th by Colonel Wilfrid Ashley, of the Commission that will inquire into road traffic is a subject for notice in this column. The Chairman will be Sir Arthur Griffith Boscawen, and the terms of reference are: "To take into consideration the problems arising out of the growth of road traffic, and, with a view to securing the employment of the available means of transport in Great Britain (including transport by sea, coastwise and by ferries) to the greatest public advantage, to consider and report what measures, if any, should be adopted for their better regulation and control, and, so far as is desirable in the public interest, to promote their co-ordinated working and development."

THE Ministry of Transport railway statistics for April last have recently been published as a Stationery Office publication, price 3s. 6d. They show that, compared with April, 1927, there was a decrease of 8·9 per cent. in the number of journeys at full fare, an increase of 5·8 per cent. in the number at reduced fares and a consequent decrease of 2·3 per cent. in the journeys made. The cheaper fares brought in an increase of 4·8 per cent., but as there was a loss of 9·3 per cent. on the full fares, the receipts from passengers were down by 4·5 per cent. The tonnage of freight was 11·2 per cent. less, which was caused by 10·3 per cent. less tonnage in general merchandise, 14·8 per cent. in minerals, and merchandise classes 1 to 6, and 10·4 per cent. in coal. Freight receipts were 8·4 per cent. less. There was a drop of 6·5 per cent. in the freight train mileage.

INVESTIGATIONS have for some time been made by the Indian Railway Board into the possibilities of meeting the increasing demand for wooden sleepers by extending the use of cheaper indigenous timbers. The investigations are being made in collaboration with the staff of the Forest Research Institute, which body has already carried out a great deal of invaluable research work in that connection. The creosoting plant which was established in the Punjab by the North-Western Railway for the preservative treatment of Himalayan soft-woods has now become an established factor in sleeper supply in that part of India. It is intended, the Indian Railway Board's annual report proceeds to say, to install another sleeper-treating plant in Assam for the preservative treatment of certain common Assam hard-woods which have been found by the Forest Research Institute's experiments to promise well as sleeper woods. Practical trials of small lots of some of the more common indigenous timbers for carriage building are also being made at the carriage shops of several railways, after artificial seasoning of the timber in the Forest Department's kilns at Dehra, Dun and Rangoon, and it is intended to build five or six complete trial carriages of similarly seasoned timbers.

IN 1887 the then Midland Railway Company constructed a curve from its Ancoats branch at Manchester to the then Lancashire and Yorkshire branch from Ashburys to Phillips Park Sidings, whereby Midland trains gained access to the Lancashire and Yorkshire system. Not only did it allow for a through express service between Bolton, Blackburn and East Lancashire, through Manchester (Victoria) and St. Pancras, but gave a route for Midland excursions to Blackpool. Of later years other companies have used that route, and on Sunday morning last a London and North-Eastern special ran from Hull to Blackpool. The train was worked by a London and North-Eastern engine on to the curve, and at Midland Junction—where the curve joins the former Lancashire and Yorkshire line—the engine was changed for a London, Midland and Scottish. Whilst that movement was being made a light engine from Belle Vue engine shed to Victoria Station ran into the rear of the standing train, telescoping the two last carriages, and killing the L.M.S. guard, who had just entered the van to take charge of the train. It is obvious that the light engine was either admitted into the section by an error on the part of the signalman in Ancoats Curve box at the south end of the curve, or the driver passed the starting signal at that box in the "danger" position.

Notes and Memoranda.

ACCORDING to Mr. S. F. Ross, of New York, a satisfactory decorative effect can be produced on rough cast concrete by painting, if there is first applied a coat of cellulose varnish and then a priming coat of lead paint.

THERE is a brief description in the *Contract Record* of how a four-storey concrete building, with walls 2ft. thick, was wrecked by means of a skull cracker. A 10-ton travelling crane was hauled up a timber ramp and was used to manipulate a 1500 lb. cracker, using the slewing gear to swing the ball against the walls. As the floors were demolished the crane was lowered to the next on a ramp.

APROPOS the decision of the Civil Court at Manchester Assizes restraining the Corporation from emitting fumes deleterious to a local farmer's land from the chimneys at the Barton power station, the *Chemical Trade Journal* says that the position is decidedly not a satisfactory one, and that it seems that the question of the commercial feasibility of the scrubbing or washing of the smokestack gases in cases such as this is worth examining. With the progress in the design of low back-pressure washers there should be no serious technical difficulties.

IT is reported from Moscow that Professor Tchernysheff, a Soviet scientifist, has invented an apparatus for the transmission of pictures over a distance. A first model of the apparatus was prepared and deposited with the Patents Committee as far back as May, 1924. Professor Tchernysheff has, it is stated, since greatly improved the construction of his apparatus, which will be finally ready in September this year, and a test will take place in October. The chief improvement in the latest construction is an acceleration of transmission. The transmission, for instance, of about 4 square inches, will, it is said, require not more than 40 seconds.

IN a recent issue (No. 8) of the *Annalen der Physik*, E. Rupp has described a neat method for preparing extremely thin foil. A small piece of metal is put in a tungsten boat in a vacuum furnace, and after preliminary purification *in situ*, part of it is distilled on to a highly polished rock salt plate. Heating is arrested when a sufficient quantity has been deposited, and the rock salt is then transferred to a salt solution, where it dissolves and leaves the metal floating in the liquid, from which it can be lifted on a frame. Layers as thin as 10^{-6} cm., free from holes, can be prepared and handled in this way, and have been used for studying the diffraction of slow electrons by the Debye-Scherrer X-ray method, in a modified Ramsauer apparatus.

PHOTOGRAPHY of the phenomena taking place when a cartridge of dynamite is detonated has shown the existence of luminous waves propagated at high speed in the air surrounding the explosive. It was at first thought by United States Bureau of Mines engineers conducting these experiments that these waves were merely reacting gases projected from the explosive, but further work in which the air around the stick has been replaced by hydrogen or carbon dioxide has made it seem probable that they are really pressure waves at such high temperature that the gas actually radiates in the visible region of the spectrum. The work is part of a programme of investigation by the Bureau of Mines of the sensitivity of explosives to detonation by influence.

IN "Some Notes from a Ship Surveyor's Diary," contributed to the Liverpool Engineering Society, Mr. F. F. Perris says that peak tanks are roomy enough, but the means of access to them are quite unnecessarily meagre, while their ventilation is frequently nil. There is really no special virtue in fitting the *smallest* size of manhole. Where a properly framed hatchway cannot, for certain reasons, be fitted there is every reason for making the manhole as large as possible. Leading directly and easily from the hatchway or large-sized manhole to the bottom of the space, with landing plates at each tier of beams, a properly framed ladder should be fitted. The common hand and toe holes cut in a centre wash-plate are abominations which ought never to have been born.

IN the *Industrial Bulletin* of Arthur D. Little, Inc., it is stated that the wires used on telephone switchboards can be flameproofed by applying a dilute suspension of selenium to the braided wire. Since selenium is closely related to sulphur and is itself combustible, its effectiveness in flame suppression is extraordinary, and for it no satisfactory explanation has yet been found. Solutions of such highly oxidising agents as potassium nitrate (saltpetre), and even the chlorates and perchlorates of potassium, are far more effective in extinguishing fires, and especially oil fires, than water alone. Comparative tests demonstrate the startling fact that a solution of such a powerful oxidising agent as potassium perchlorate is five times as effective as one of potassium chloride and nearly twenty-five times as effective as a solution of common salt. These discoveries have already received practical application in a new type of portable fire extinguisher.

THE Pacific Experiment Station of the United States Bureau of Mines, Department of Commerce, in its work on the determination of physical and chemical properties of the oxides of metallurgically important substances, has encountered the problem of preparing pure ferrous oxide. It seems to have been prepared pure by previous investigators only in minute amounts of less than $^1/_{10}$ gramme, whereas samples of several pounds are desired for the usual determinations of specific heats, heats of formation, &c. The oxide is metastable below 500 deg. or 600 deg. Cent. and must be prepared above and rapidly chilled through this range, even to produce relatively impure material. A common method of preparation has attempted to reduce magnetite by means of metallic iron. Experiments carried out in a specially designed high-frequency induction furnace of vacuum type and provided with a specially efficient means of chilling the product showed that repeated treatments of fused iron oxides with pure iron between the melting point of the oxide and that of the iron consistently gave only about 85 per cent. limiting purity. This constitution seems to be a steady or equilibrium condition, and the proof that such limits exist has important bearing on certain problems involving ferrous oxide, not only in connection with the metallurgy of iron, but also with studies of the condition of copper-smelter slags and mattes.

Miscellanea.

A NEW coal mine is being opened on Vancouver Island, 7 miles south of Nanaimo.

ACCORDING to the *Daily Telegraph*, one of Herr Fritz Opel's rocket driven cars is to be exhibited at the August Bank Holiday meeting at Brooklands.

THERE has just been published by H.M. Stationery Office No. 6 of the Building Science Abstracts, issued by the Department of Scientific and Industrial Research. The price is 9d. net.

THE latest prospecting bore-hole put down by the N'Changa Copper Mines, Rhodesia, has revealed a seam of ore containing 4·56 per cent. of copper, 130ft. thick, at a depth of 320ft.

DURING the past six months forty-three vessels of 162,513 tons were launched on the Tyne, representing an increase of twenty-one vessels and 64,075 tons over the corresponding period of last year.

A CONSERVATION dam is to be built near Kenora, Ontario, with a view to benefiting and increasing power holdings on the English and Winnipeg rivers. The dam will be near the Lower Ear Falls at the western end of Lac Suel.

THE coal-handling plant at Three Rivers, Quebec, of the Dominion Coal Company is to be extended, and will have a storage capacity of 200,000 tons. It is expected that the new plant will reduce the time occupied in unloading vessels to one-third of that at present necessary.

THE well-known wireless station at Scheveningen (Holland) now issues a daily telephonic message for the benefit of the Dutch herring boats at work in the North Sea. The messages are sent out on a wave length of 1875 m. every day except Sunday, at 5.45 p.m.

OF the space which will be available at the Birmingham section of the British Industries Fair, to be held next year from February 18th to March 1st, only 10,000 square feet now remain for allotment. There seems to be a general tendency for manufacturers to ask for about 30 per cent. more floor space than they occupied at the last Fair.

IT is reported that in the exploitation of the new "Duffield" process for the manufacture of iron and steel a further step has been taken in the purchase of land near Banbury by Lindley, Duffield and Co., Ltd., and that the preliminary work of surveying, prior to the erection of buildings and the installation of plant and machinery, is now being undertaken. The land acquired is described as overlying extensive iron ore deposits, and including the Cochrane ore mine, which for the past few years has been closed down owing to the depression in trade.

THE Metropolitan Railway Company has now placed an order for the remodelling of their existing boiler plant at Neasden power station. The plant at present consists of twenty boilers, stoker fired, and the new order, which has been placed with International Combustion, Ltd., will replace those by six boilers of the vertical bent-tube Lopulco type, fired by the company's bin and feeder system of pulverised fuel firing. The new plant will embody the contractor's latest features in pulverised fuel installations, including drying the raw coal during its progress through the mill circuit.

REPORTS on fifty-seven separate American overhead lines operating above 100 kV, and totalling 2239 miles in length, show 11·77 interruptions per 100 miles of line. The lines reported are situated in Wisconsin, Illinois, Indiana, Ohio, and Michigan. About 67 per cent. of the causes of interruptions were stated to be lightning, the failures per 100 miles being 7·94. The largest remaining group of causes was listed as "Unknown and Miscellaneous." Accidental earths and mechanical failures were very few. Practically all troubles were on a single phase; phase-to-phase short circuits were not over 4½ per cent.

A COMPANY, known as the Northern Rhodesia Lime and Cement Company, Ltd., with a capital of £200,000 in 800,000 shares of 5s. each, is being formed for the manufacture of Portland cement, and the preparation and sale of various grades of lime, at the Chipongwe Estate. Chipongwe is situated some 350 miles north of Wankie, on the main line of railway to the Congo, and is 106 miles by rail south of Broken Hill, and 235 miles from the Congo Border. The estate contains large deposits of a blue banded limestone containing an average of 95 per cent. calcium carbonate, together with shales and clays, all suitable for making a high grade of Portland cement.

OFFICIAL Austrian statistics recently published show that during 1927 seven comparatively large hydro-electric power stations, with a mean annual capacity of at least 500 horse-power each and a total mean annual capacity of 36,000 horse-power, were constructed. The total number of large hydro-electric power stations constructed in Austria since 1919 has been increased by these activities to seventy-eight, with a total mean annual capacity of 178,955 horse-power, a turbine capacity of 367,937 horse-power, and a maximum annual output of 963,100,000 kilowatt-hours. An average of about 20,000 horse-power has thus been added annually for the last nine years, and developments during 1927 were well above the average.

THE death is announced of Dr. Charles Macdonald as having taken place on July 8th. Dr. Macdonald, who was 91 years of age, was born at Gananoque, and was a graduate of Queen's University, Kingston, and the Rensselaer Polytechnic Institute, of Troy, N.Y., subsequently entering the service of the Philadelphia and Reading Railway Company, at Pottertown, Pa. He joined the Federal Forces during the American Civil War, and was captured by the Confederates, but released on parole. After the war Mr. Macdonald became the first President of the Union Bridge Company, which position he retained until the company was absorbed by the United States Steel Corporation. He was identified with many important engineering works, including the construction of the bridge over the Hudson River at Poughkeepsie, N.Y.; the Brooklyn Bridge, and the Hawkesbury River Bridge, in Australia. After retiring from active practice, Dr. Macdonald was for some time employed as consulting engineer for the Quebec Bridge over the St. Lawrence River.

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(*For description see page* 115)

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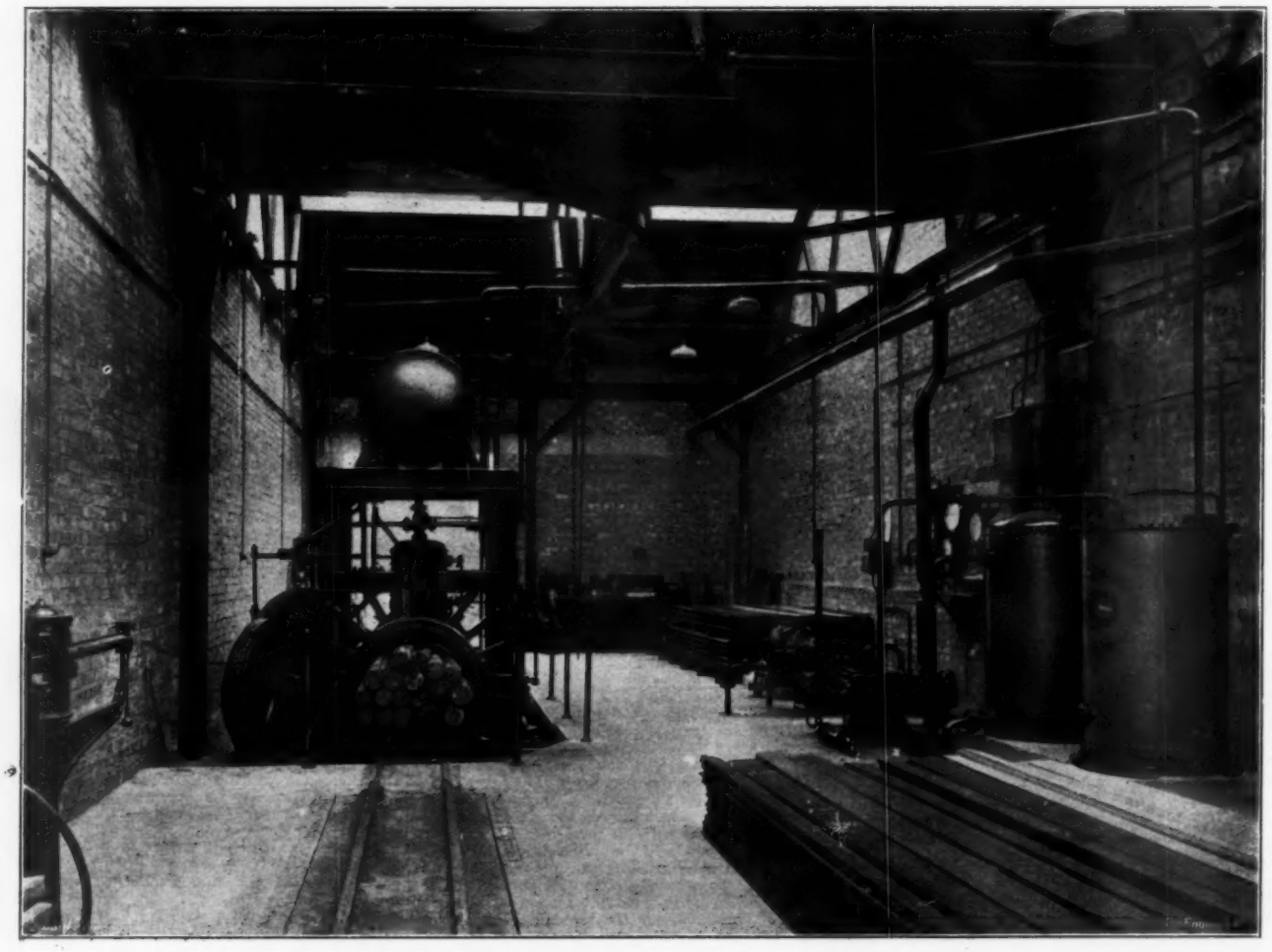

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DEATH.

ON Tuesday, July 31st, at a Birmingham nursing home, EDWARD CHARLES ROBERT MARKS, A.M.Inst.C.E., M.I.Mech.E., partner in the firm of Marks and Clerk.

THE ENGINEER.

AUGUST 3, 1928.

Apprentices.

DESPITE changes in engineering workshop practice which have reduced the necessity for manual skill, the need for a continuous supply of well-trained men is almost as great as it ever was. It was shown during the war that men and women, boys and girls, could be taught in a few weeks to perform certain operations with considerable skill and quickness. It still remains a fact that any person who is content to devote his life to the handling of a single type of machine on a single operation requires little or no training and little or no intelligence. The monotonous action of pushing little bits of steel under a press for conversion into the links of a bicycle chain would not overtax the mental abilities of a chimpanzee, and the operation of many single-purpose lathes call for but little, if any, more skill or intelligence. But, on the one hand, no one who takes thought for the future of his country desires to see the bulk of the industrial population reduced to the level of Robots, and on the other hand, the majority of manufacturers, amongst engineers at least, are convinced by experience that, in the long run, the works which employs the largest number of intelligent trained men turns out the best product. The tendency should be, and possibly is, to make automatic those operations which make no demands upon the intellect and very little upon acquired skill, and, by so doing, to increase the ratio of those in which skill, knowledge and quickness of intelligence are necessary. One has only to pass through a modern rolling mill to see the extent to which brawn-without-mind has been replaced by mechanical appliances. The amount of labour per ton of product is, of course, greatly reduced, but applied intelligence per ton of product is higher than ever. There is, moreover, a sociological effect which cannot and must not be overlooked. Education will fail in its purpose if it does not cause a steady increase of those who are not content, year in and year out, to make no use of their minds. They may, indeed, employ their leisure to better advantage and compensate themselves thereby in some degree for the mental lethargy of their vocations ; but, with the improvement of the world in view, we may look forward to the time when skill-less occupations will be left to those who have no intelligence worth developing, and when youths who have been able to profit by mental and manual training will devote themselves to crafts which give reasonable exercise to their talents. We know not how much of the industrial happiness which prevailed, let us say, in Elizabethan days was due to the fact that every workman had to be skilled in the handling of simple tools and could find a real joy in the mastery of their qualities. The pleasure that the amateur mechanic of to-day finds in his workshop is closely akin to that of the worker in days before the perfecting of machinery had diminished the value of craft and the coming of the rig and the jig had cut away the intelligence which was called for in the setting up and chucking of tricky parts. In those and even in later days machines had their own idiosyncrasies ; the man who knew the machine could get good work out of it—he knew just where the low spot came in the lathe bed—but no one else could. Nowadays the machine with an idiosyncrasy is anathema to the works manager, who rightly insists that all must be kept up to a state of perfection. It is only in very little works or repair shops that you may still find drills and lathes that must be humoured, or in which an intelligent workman has to devise means of doing works with inadequate means. For that reason works of the kind have an attraction of their own, and are unsurpassed for the training of craftsmen, though they may fail, owing to their lack of modern methods and appliances, in the training of engineers.

In view of the pleasure which is derived from craftsmanship and the need for an ever-increasing number of well-trained mechanics, it is a little disconcerting to learn from the General Report of an Enquiry into Apprenticeship and Training for the Skilled Occupations which has just been issued by the Ministry of Labour (price 5s.), that apprenticeship in the engineering industries is barely sufficient to meet future needs. "The maintenance of an adequate supply of skilled workmen to meet the needs of industry is a matter of vital importance," says the Report, "not merely to industry itself, but to the community as a whole. It is important to employers, because the uninterrupted flow of a sufficient number of workmen with the requisite skill is essential if the continuity and progress of industry are to be assured ; to workmen, because the maintenance of a high standard of skill profoundly affects their economic status and prospects ; to the community, because its interests and duty lie not only in ensuring the economic welfare of its citizens, but in fostering a high standard of education and of citizenship." Apprenticeship is still by far the most systematic method of entry into the ranks of skilled men, yet, excluding the textile industries, only about one-fifth of the youths under twenty-one years of age are following it, in all industrial occupations. In the engineering industry there are less than forty-four thousand apprentices ; in shipbuilding something over thirteen thousand, and in the metal industries about two thousand five hundred. It is not easy even with the help of the tables given in the Report to arrive at a clear conclusion as to the maintenance of the necessary proportion of apprentices to journeymen, but the following passage from the Report may be accepted as an indication of the position in 1925–26 :—"In all skilled occupations in the building industry except plumbing, and in the principal occupations of the printing industry, it appears unlikely that the existing proportions are sufficient to maintain the present rate of expansion in these industries, while the existing proportions in the case of moulders and brassfinishers (engineering) and riveters (shipbuilding) are probably insufficient to maintain the number of journeymen now in the industries." It is necessary to note, however, that employers as a whole are satisfied that the present methods of recruitment for apprentices and learners is adequate to provide a sufficiency of men with the requisite skill. We suggest, however, that in many cases the standard of skill is so low that no previous training of any kind is required, and that satisfaction with the present system indicates a falling off in the general all-round quality of workshop labour. The best men, charge hands and so on, are better, by far, than ever before, but the improvement of mechanical methods has brought about the employment of a far larger proportion of unskilled men than in former times. But we would not have it thought that employers as a whole are indifferent, and we remember with pleasure that many of the greater firms take especial pains, not alone to train but to educate technically

their apprentices. Yet here again a remarkable fact is brought out in the Report. It appears that the smaller firms train the greater number of apprentices, the larger firms drawing their supplies of trained men from the smaller works. "This failure," says the Report, "to train the proper quota of skilled men, which appears more particularly among some of the larger firms in the bigger centres of population, may presage difficulties for the future and is unfortunate in so far as training is denied to boys in many establishments with equipment and resources which could be adapted, with the happiest results, for this purpose." We ought, perhaps, to add that this stricture does not apply only to engineers; the Report is speaking of the country's industries as a whole. As a matter of fact some 60 per cent. of the employers in shipbuilding and engineering take apprentices.

When we recall the great efforts that have been made to restore apprenticeship to its old position, often with the benevolent intention of keeping boys out of blind-alley occupations, it is rather curious that the series of reports of which this General Report is the last, represents the first attempt that has ever been made thoroughly to survey the position. That the Ministry of Labour should have set about the matter may be taken to indicate a growing appreciation of the incontestable fact that the welfare of national industries depends in a great measure upon the quality of the labour in them. When, let us say, a hundred years ago all men in an engineering works had to be skilled in some craft, we had in Great Britain the finest workmen in the world. With the gradual modification of workshop methods, and particularly with the introduction of methods which enable semi-skilled, and even unskilled workers, to earn more than those who are fully trained, a change has crept in. We have no reason to suppose that the ratio of trained to untrained men is lower in this country than elsewhere, or that the general standard of workmen in engineering workshops is not as high in Great Britain as in other lands. Indeed, we are disposed from observation to the view that our men are still as good as any in the world and far better than most. But advanced thinkers in this country, as in Germany, Switzerland, and America, look towards a still higher standard, for they believe that with better educated and better trained workmen a still higher class of product is possible. If they are right, and we sincerely believe that not only the quality of the products but the happiness of the people is involved, then it is the manifest duty of all employers to encourage apprentices and learners by all the means in their power, and, when the time comes, to give every possible opportunity for advancement to those who have been educated and trained for the industry.

Railways and Labour Costs.

WHEN the serious financial condition of British railways is discussed, it is usually ascribed to road competition, bad trade in the coalfields, the failure of trade generally to revive, and the greater use of private motor cars. The real cause is but rarely mentioned. It is the high wages bill. These are days of short memories, or, perhaps, it is that events now move so swiftly that they do not make as deep an impression on the mind as they used to do, and so are the sooner forgotten. Few, we anticipate, now remember that after war broke out the railways were the first industry to be controlled by the Government. An agreement, creditable to both parties, was soon arrived at. It ensured to the railways the net profits they had made in 1913. That was at the time a relief to the companies as it guaranteed their financial position in any event, and particularly as 1913 had been an uncommonly good year; it was to prove a yet finer proposition for the Government for, during at least the four years of hostilities, the railways were run with considerable advantage to the State. More than that, they were operated to the immense advantage of traders, as although the working costs were much greater—owing to higher wages, dearer material, and, as a result of the greater value and vital urgency of most of the traffic itself, comparatively extravagant operation—there was no increase in the rates over the pre-war level. The railways were, in a sense, the property of the Government, which, in effect, said to the companies: "We are out to win the war; the cost is a minor matter," and the Railway Executive Committee of railway general managers, which ran the lines, with a patriotism which did them credit, refrained from embarrassing the Government with proposals that would have led to the railways being made more nearly self-supporting. In due time war traffic fell off—but labour and material remained high in cost—and the day of reckoning came. In January, 1920, after carrying for five years or so the most valuable freight traffic possible at pre-war rates, an increase in tariffs was made, and whilst they are slightly lower now—all the reductions, be it noted, having been made since the railways were decontrolled in August, 1921—the still high rates of to-day are based on those created at that time. The reason why they have not yet been further reduced is mainly that the cost of labour is so high. That, as we now propose to show, is one of the consequences of the seven years' Government control of railways.

From any consideration of the question as to the concessions given to railwaymen during the period just named, we entirely exclude the war bonus, as that may be regarded as an offset against the increased cost of living. We have in mind principally the general granting of the eight hours' day and other concurrent benefits. At the present moment, in view of the generous attitude of the men in agreeing to a temporary reduction in their wages, we regret to have to cast any reflection on their past conduct and particularly so as regards the enginemen. We said, in our opening sentences above, that these are days of short memories, and, therefore, many may have forgotten that in the August of 1917, when the nation was going through one of her severest trials, the members of the enginemen's society would not accept an offer which the National Union had agreed to, but threatened to strike unless they were given the eight hours' day. It was only when Sir Albert Stanley, the then President of the Board of Trade, had promised, on behalf of the Government, that within a month of the cessation of hostilities the question should be considered, that the strike threat was withdrawn. The Armistice was signed on November 11th, 1918, and without waiting to see if fighting was resumed, the Government was reminded of its promise, and on December 6th a meeting took place—at which no representative of the companies was present—and not only was it agreed that an eight hours' day should be operative from February 1st, 1919, but that a new committee, to deal with pay and conditions of service, should forthwith be set up. Many railwaymen—all the shunters, about one-half of the signalmen, most of the goods guards, and a goodly number of the enginemen—already had the eight hours' day, and no one would complain of its extension generally among men so deserving and having such responsibilites, even although no difference was made between the men on branch lines and those in the busiest termini. It was, however, the concessions made by the new committee on pay and conditions of service that were, later, to handicap the companies, in that the operating expenses were at once increased by a large percentage through payments of a guaranteed week and excess rates for Sunday duty, night duty, and overtime. The generosity of the committee may now be criticised, but it must be remembered that at that time a generous feeling was in the air—hostilities were over and the enemy beaten. Railwaymen, too, at home and in the field, had done uncommonly well for their country. So they should have what they asked for. Moreover, the railways were still controlled, and there was the promise made on September 5th, 1916, by Mr. Runciman, and renewed by Mr. Bonar Law on January 29th, 1919, that the Government control of the railways should continue for two full years subsequent to the declaration of peace—and that, added Mr. Law, meant final peace, and not Armistice. The most important feature about the whole of that affair remains, however, to be related. It is that in discussing the questions with the men, the general managers were tied by decisions already made by the Government. The Board of Trade announcement at the time spoke of representatives of the Government and of the railway unions being present, and added that "the whole of the concessions offered by the Government were reviewed." It is also significant that the agreement concluded with the statement that in the new Ministry [of Transport] it was the intention of the Government to provide for, and to avail itself fully of, the advantage of assistance, co-operation, and advice from the workers. The Government subsequently did its best to redeem its promise. The proposals as to the future of British railways, outlined in White Paper Cmd. 787 in June, 1920, proposed that railway labour be represented on the boards of the companies. However, by the time the Railways Bill, 1921, was introduced, the men had decided to leave themselves in the hands of the companies. That that confidence was well placed has frequently been shown, and never more than in the agreement arrived at last week—one of the most remarkable labour agreements ever arrived at—that all in the railway industry, high and low, should accept a 2½ per cent. temporary reduction in their wages.

By this brief outline of the recent history of railway labour, we wish to show that the cost of railway labour is excessively high, and that the Government, and not the companies, is to blame. The savings that will now be possible will afford considerable relief, and we trust that the praiseworthy sacrifices of men and officers, and the earnest efforts of the men's leaders towards peace—on which both the companies and their men are to be congratulated—will enable the railways to win through until better days come. They have now three important forces working in their favour—first, this reduction in wages; secondly, de-rating; and, finally, the road powers recently secured. It is to be hoped that as a general result, a material reduction of railway rates may be effected. What will happen as a result of the road powers is still uncertain, but the companies are administered by wise men, who are not likely to embark on any costly schemes, and we shall probably see the desired end attained by some transport concerns being bought out and by co-operation with others. The railways have been blamed for not obtaining those powers earlier, thereby preventing private companies getting so deeply into the business. But it must be remembered that such powers were sought by some companies six years ago, but were defeated by conditions brought forward at a very late stage in the parliamentary proceedings by the Ministry of Transport. Since then the companies have had to complete their grouping schemes and to get their houses in order when amalgamation was completed. A still greater task has been the work before the Railway Rates Tribunal to secure the standard charges provided for by the Railways Act of 1921, and preparing for the "appointed day," which only arrived at the beginning of the present year. They have now completed these great undertakings, and the prospect which opens before them is brighter than for many years past.

Notes on the Design of Propellers.

By G. S. BAKER, O.B.E., M. Inst. N.A.

No. I.

IN the course of the last few years a considerable amount of data dealing with the design of propellers and propeller blades has been published. The majority of these data has been simply a record of tests made on models in a tank on a quite small scale. One of the great difficulties in applying any such data is to visualise the restrictions of their application. Failure to do this has occasionally resulted in some change which has proved successful in one ship being tried on another ship—not always with an intimate knowledge of the intrinsic feature involved—with bad results, thus throwing doubt on all the data concerned. As a result shipbuilders and owners have been very cautious in making any changes from the more or less standard type of propeller.

Any device or modification will be found to have its definite restricted area of usefulness, and, if used outside these limits, it will give either a neutral or worse result. Sometimes these limits are made apparent by the small-scale experiment with propellers, sometimes model data of various kinds have to be used in reasoning what the limits are likely to be; but one is never quite certain whether the limits will be exactly the same on the ship as on the model. We know in fact that the model experiment does not represent the ship as closely as one could wish in certain characteristics. For example, it has been demonstrated that the propeller revolutions for a ship in load condition, estimated from model experiments by certain definite methods, are very close to those actually required. But if the same methods are used with the ship and model in light condition the propeller breaking the surface, the revolutions for the ship estimated from the model will be too low.

Largely as the result of model tests, there are certain changes which have been made and successfully applied to the ship, and others which are now being tried; and it is proposed to discuss these in some detail to give some of the reasons and ideas underlying the changes and where possible to indicate their broad limitations. Part of the difficulty of propeller design is that it is never possible to meet every demand, and one quality or another must be sacrificed to meet certain essential requirements, which vary from ship to ship. For this reason it should be made clear that these notes are written mainly for such cases as are met in ordinary mercantile practice. Where some qualification is required—as in some fast ships—reference to this has been made when it has been within our knowledge.

Before passing to the consideration of the specific

features of propellers it is well to review the main requirements of a marine propeller. Put broadly, these are :—

(1) That the propellers shall work with good efficiency at a ship speed which does not vary very much—or should not—for each ship when the revolutions are maintained at a specific rate ; and

(2) That in bad weather the screw shall be such that the revolutions need not be lowered seriously and the thrust shall be maintained so that the drop in speed is as little as possible.

Quite apart from the effect of special features of the propeller itself, there are certain conditions as regards environment, which should be met, and the ability to meet requirements (1) and (2) will improve the more nearly these conditions are satisfied.

The first of these conditions is the freedom of the screw disc from any eddy making due to the hull or its appendages. The second is that the flow immediately in front of the propeller shall be as nearly as possible fore and aft, *i.e.*, there shall be no cross flow. It is not necessary to enter here into a long discussion as to how the first of these conditions can be met. In a twin-screw ship it should always be possible. In a single-screw ship eddy making can rarely be entirely eliminated without the use of a cruiser stern—and this is not feasible when a large screw is necessary—but it can be confined to the upper levels. It should be noted that eddy making at the stern is greatly accentuated when a ship runs into shoal water, and those ships which normally work in shallow places should be quite free from this defect, even on levels well above the screw disc, or their propulsion and their steering will suffer seriously, although in deep water both may be passable. Oblique flow into the propeller can be reduced by the combination of a certain amount of club-footing on the aftermost frame sections and the elimination of any pronounced shoulder or steep levels either on the load line or below in the after body. In twin-screw ships the solid bossings should be so placed that they create the minimum of disturbance of the direction of flow of the stream lines. It might appear at first sight that this flow aft would vary quite considerably with the condition of the ship, but actually it is found not to be very sensitive to moderate changes of draught and trim.

It has already been stated that these steps will only produce a partial avoidance of cross flow. In single-screw ships the stream lines near the hull necessarily have some angularity, and in twin-screw ships a pronounced broad cruiser stern with very fine-ended lower levels will be accompanied by quite fair angularity, varying in character and direction at different levels, with or without solid bossings. As some of this must be accepted as inevitable, steps must be taken to prevent it from producing bad results, and so we come to our first feature in propeller design, namely,

The Position of the Propeller Relative to the Hull.

With twin-screw ships the main consideration is to obtain reasonable blade tip clearance. The frictional wake belt has very high forward velocities in the layers close to the hull plating. This velocity diminishes as the distance of the layer from the hull increases, at first rapidly and then more slowly, particularly in the after body. It is highly desirable to escape this inner *high velocity* layer, and it would appear that about 1ft. clearance in a normal sea-going ship is required for this. In some small and high-speed ships not even this much is feasible, by reason of draught or other considerations. In such cases it is wise to cut the diameter as low as possible consistent with cavitation limits and reasonable efficiency on standard screw data, and so conserve as good a blade tip clearance as possible.

But it is also desirable that the hull shall leave the screw free to perform its work without serious efficiency loss, and for this a clearance represented by a fraction of the screw diameter seems to be wanted. This fraction for normal speed merchant ships has been taken as one-eighth, in many cases with good results, although with high-speed ships in which the pressure per square inch of blade area is high more than this is desirable.

The second consideration is to obtain all the advantage possible from the ship's wake, *i.e.*, from its stream line wake due to the flow around the hull. It has been stated by some authorities that "wake gain" is a myth. But a single example will show that this is far from being the case. In my paper read at the 1927 summer meetings of the Institution of Naval Architects, the wake fraction of a 28ft. plank is given as 0·15 to 0·21. This was obtained with tank screw V working behind it, and was checked by pitot tube measurements of the water velocities. This screw, behind the plank, when delivering a thrust equivalent to self-propulsion of the plank, had an efficiency of 0·63, but the actual measured propulsive coefficient of plank and screw was 0·73—the thrust deduction fraction being zero, the full wake value was reflected in the propulsive coefficient. The same kind of thing can be seen for a full type of merchant ship, by reference to the last table in the paper read at the 1928 spring meetings of the Institution of Naval Architects, by Mr. Kent and myself. The propulsive coefficient obtained with this same screw V behind a ship hull, varied from 0·65 to 0·75, although the efficiency of the screw alone was much lower.

Taken as a general rule, the farther aft and closer in the screw is placed, the more chance there is of obtaining some return from the wake. To prevent any misunderstanding, it should be made clear the term wake is not intended here to cover "dead water." It is quite true that the presence of dead water and eddy flow will give an apparently high wake fraction, but nothing useful can be gained from it as wake. For wake flow to be useful, it must not be moving forward at too high a rate, and must not be in turbulent eddy motion.

If the engine revolutions are high for the speed, a high wake is not conducive to good results. This has lead to the screws being placed low down relative to the hull to escape from the slow water of the higher levels, and in full-ended ships this causes the steering to be defective in shoal water. It is better therefore in ships of this type which regularly make the passage of the Suez or other canal to spread the screws more, keeping them up at normal level, and by elongating the rudder a little, to secure the necessary steering qualities.

In single-screw ships, one small point requires attention. In any 300ft. to 500ft. ship the width of body post plus side plating may be anything from 9in. to 1ft. It is a fairly well ascertained experimental fact that, behind a flat face of this width, eddies will be formed, and will extend back for a distance roughly twice the total siding, *i.e.*, 1·5ft. to 2·0ft. It is never wise to work propellers in such eddies, and the leading edge of the blades should in no case come within these limits, and, if possible, some margin should be allowed, especially in high-speed ships.

In single-screw ships, apart from the question of rake which will be considered later, there is little practical possibility of movement except vertically, and any vertical movement affects the diameter. Now, in the usual type of single screw ship with low revolutions and high wake, a large diameter is called for. It is desirable, however, to keep the screw disc immersed as much as possible in all conditions, and to do this one would be prepared to cut the diameter a little. But if a normal 18ft. diameter screw is reduced to, say, 14ft., whether to meet this particular desire, or to adapt the propeller to a high revolution engine, it is essential that the hull be redesigned to meet the new conditions and to reduce the eddy-making aft. Even then, some small sacrifice of efficiency would have to be accepted in load condition, in order to get the screw better immersed in light condition.

Propeller Boss.

There are three points which arise in regard to the boss. The built-up *versus* the one-piece propeller, the maximum diameter of the boss, and the shape of the boss in a fore and aft direction. The most common practice in merchant ships is to have a boss to which the blades are bolted, the holding nuts being covered by a "cake" of cement. The boss itself may be more or less cubic or spherical. The arrangement has definite advantages as regards storing spare parts, repairing broken blades, &c., but these things do not come within the scope of this article. In 50 per cent. of our ships, there is a large gap between the after end of the spectacle frame—or the shaft tube end—and the fore side of the propeller boss. In such an arrangement the gap is bound to cause some discontinuity of flow of the water near the boss. When the water has passed this obstruction it meets the cement covering the bolts, and the odd shape which this usually takes is not conducive to steady flow. It has already been stated that it is not good to have eddies formed near the leading edge of the propeller, and the natural result in this case is a falling off of efficiency. Several model tests have shown that this may vary from 2 to 6 per cent. according to details.

The cure for this is the one-piece propeller, as in this case the boss can be given a shape which follows on from the shaft tube without any abrupt change of curvature, and by fitting a suitable rope guard between tube and boss, the whole defect can be eliminated. But some ships are continually in confined waters, and the liability to break a propeller blade is very real. For such ships the built-up propeller is almost a necessity. Efforts have been made therefore to overcome this loss, without necessarily going to a one-piece propeller. Tests have shown that the larger boss diameter required with a built-up propeller is not the main cause of the loss, and that the latter appears to be mostly due to too rapid curvature of boss and cement line in a fore and aft direction, and the impossibility of giving the cement a reasonable shape. To overcome both these troubles we have introduced a boss having a barrel shape, the ends of the boss being larger than usual, so that the cement covering the blade bolts can be contained within the boss barrel at the ends. The leading edge of the propeller blades are then clear of all obstruction, and, with a suitable rope guard, the boss and guard has a comparatively flat curve fore and aft. This will give a result very nearly as good as a one-piece propeller of smaller boss diameter. It requires a special spanner for releasing the blade bolts, but this is a small matter which can easily be met.

The one-piece propeller still retains a feature not possible with the built-up, which is distinctly useful in some cases. The sections of the blades near the root are always rather thick relative to the length of the chord of the section, *i.e.*, the "camber ratio" is high. It is well known that a section of excessive camber ratio suffers in efficiency at all angles of attack. In the one-piece propeller it is possible to ease this ratio by carrying the blade over nearly the full length of the boss. In the built-up propeller, the length of the blade section at the root is confined to the diameter of the palm of the blade. In the former, therefore, somewhat better results can be obtained, owing to the improvement near the boss. As a corollary to this, one might remark that, in a built-up propeller, there is an underlying assumption that it may be necessary to change the pitch—hence the slotted holes and circular palm base for the blades. But change of pitch is rarely wanted, and in most cases could be given up. This, of course, would mean that the pitch of the blades on trial would be the same as on service, which would be a distinct advantage, in the writer's opinion, as giving a better test of the ship. If change of pitch is given up, the palms could be elongated, the root sections of the blades made longer, and the built-up propeller would then have an efficiency very close to that of a one-piece propeller.

Rake and Skew of Propellers.

These terms are used a little loosely in practice. To make the following notes clear the term rake is defined as the bending of the propeller blades aft relative to the boss, or the slant of the strickling blade when sweeping up the pitch surface. By skew is meant the movement of the tip of the blades around the propeller shaft relative to the root, the pitch remaining constant.

Many years ago Froude tested some propellers in open water—*i.e.*, by themselves—with and without rake, and found that the rake had no effect. Taylor made similar tests and obtained much the same result, with this addition, that when the blades were given negative rake the efficiency was a little worse than with no rake. It has been generally assumed since that this result applies to a propeller behind a ship hull. Now, in both of these sets of model tests the propellers were well immersed. Tests which have been made in recent years have shown that this is an important point, particularly in single-screw ships. A large proportion of merchant ships spend a quite fair amount of their time running in a light condition with their propeller slightly out of water. Even when the propeller is nominally immersed, in rough weather the pitching of the ship may bring the propeller partially out of water.

Model tests in the tank have shown that, as a propeller emerges from the water, the thrust it exerts falls considerably, but with large rake this fall in thrust is much less marked than with no rake. The fall in thrust is accompanied by only a small drop in efficiency. If the thrust falls there is a tendency for the engine to race, the engine revolutions are eased down, and the speed will follow suit and drop. By giving the propeller quite considerable rake this breakdown can be mitigated and the ship keeps a better speed both in rough weather and in ballast. But apart from this, or rather in addition to it, in a single-screw ship with full-ended top level lines rake will give a better efficiency even in smooth water. The gain is not large and will vary from nil to 3 or 4 per cent. within practical limits of rake. Both these effects add to the general efficiency of the ship and to its speed-keeping qualities, and have been checked out on single-screw ships and corroborated by their results on service.

The explanation is believed to be twofold. First, even if air gets to the blade tips at the top of the screw disc, with good rake there is now a component velocity of the water keeping air from passing forward down the blades. Secondly, with full-ended level lines the penetration of air is quite often due to the formation of a large eddy just in front of the screw at the water surface. With good rake the formation of this eddy is much less marked and the eddy is shallower, as the race velocity set up in front by the advanced portion of the blade towards the root always hinders its full development. It is believed that skew back acts to a certain extent in the same way and for the same reasons.

With twin screws, the liability of breaking surface is very much reduced—except in river boats—and there seems to be little or nothing in rake or skew back as regards propulsive efficiency. But rake is an easy way of obtaining a small addition to the blade tip clearance without spreading the shaft lines. In the locality of the propeller the lines of the hull are sloping at an angle which varies from 5 deg. to 15 deg., and 1ft. rake will give another 1in. to 4in. more tip clearance. It also carries an advantage in this respect : one can never be certain that shaft bossings and webs are not producing any skew flow near the propeller. If the blades are kept well away from the after end of the bossing any such motion will have little effect. On several occasions records of propeller thrust have been obtained on ships, and some of these have shown a quite definite kick or hump due to each blade as it passes the line of the shaft bossing. Recently the blades of both twin and single screws have been given some skew in order to spread out and therefore ease this hump. These are points which are quite evident from the ship tests. They are not

brought out in tank tests, and any such tests on a reasonably good hull with good tip clearance for the screws will give results as regards the use of rake in accordance with Froude's conclusions.

(To be continued.)

Heaton Park Service Reservoir.

We give, in what follows, an abstract of a paper on "Heaton Park Service Reservoir," which was read by Mr. Samuel Hall, Assoc. M. Inst. C.E., at the recently held summer meeting, at Manchester, of the British Waterworks Association. Mr. Hall, it may be mentioned, was appointed Resident Engineer at the Reservoir in March, 1922, under the supervision of Mr. L. Holme Lewis, M. Inst. C.E., the Manchester Corporation Waterworks Engineer.

The Heaton Park Reservoir, which lies about 4 miles north of Manchester Town Hall, was designed to supplement the storage accommodation for Thirlmere water, as the two pre-existing reservoirs, which have a combined capacity of 41 million gallons, were too small for the increasing requirements of the city.

The original designs for the reservoir, which, it was proposed, should contain 500 million gallons, were prepared by Messrs. G. H. Hill and Sons, of Manchester. It was, later, decided, by raising the embankment by 2ft., to increase the storage capacity to 615 million gallons, and, as actually constructed, the reservoir will have a maximum depth of 56ft. 6in. and an available depth of 51ft. 1in. The area occupied is 96 acres and the top water area when the reservoir is full will be 77½ acres, the top water level being at 349ft. above O.D.

For bringing water to the reservoir there are one 40in. and one 36in. pipes for Thirlmere water and provision has been made for three 36in. pipes for Hawes water when the latter is available. Three 36in. pipes run from the reservoir to the city.

Constructional work was begun as long ago as 1907, the contract being in the hands of J. Byrom, Ltd., of Bury. The Stanton Ironworks Company, Ltd., had the contract for the necessary cast iron pipes and specials, and Glenfield and Kennedy, Ltd., the contract for the valves and special ironwork for the inlet and outlet wells. It was anticipated that the structure would have been completed in 1912, but owing to difficulties having to do with the nature of the clay for the puddle and the quality of the puddle work, progress was delayed, and finally, in 1915, when only 59 per cent. of the puddle lining was done, work was entirely stopped because the Government commandeered, for war purposes, the rails, &c., used on the works. Operations were suspended until the end of 1921, when, in order to provide work for the unemployed, the City Council decided to proceed with the completion of the reservoir by direct labour and a start was immediately made, actual constructional work being begun again in June, 1922.

Fortunately, a careful search had revealed the up-till-then unsuspected existence of a deposit of nearly one million tons of clay about one mile from the reservoir site, so that all difficulty in that direction was done away with.

By April, 1926, the work was so far advanced as to permit of the closing down of scour valves in order to collect the rainfall. The lining and embankments were completed by September, 1927, but the construction of the embankment wall has been postponed until after the filling of the reservoir.

In what follows we quote Mr. Hall's own words.

Description of Reservoir.

The reservoir is of a type which might be described as a bowl of puddled clay, built upon an elevated site. A plan of it is given in Fig. 1, while the cross sections, Fig. 2, show details of the embankments, puddle core wall and puddle lining.

The puddle work, ensuring the water-tightness of the reservoir, extends under the inner slope of the embankments and is carried vertically upwards as a puddle core wall. The thickness of the puddle lining is 5ft. where the depth of water is 51ft. or more, but is gradually reduced to a minimum thickness of 3ft. where the depth of water is 17ft. or less. The maximum slope of the puddle lining laid by contract was 1 in 5, but in the administrative period the ruling gradient was 1 in 8, as puddle laid on a 1 in 5 slope is liable to "belly," and, moreover, the flatter slope not being so liable to wave erosion, requires less protection.

The requisite protection of the puddle lining from the effects of sunshine, frosts and waves consists of a covering of gravel and stonework. The protective covering laid in the pre-war period was of squared rubble pitching, 8in. to 12in. in depth, upon 4in. to 6in. scaplings with a 6in. layer of gravel or broken stone between the scaplings and puddle. In the administrative period the covering consisted of rough rubble pitching, 12in. to 14in. in depth, blinded with gravel and laid upon a 6in. bed of gravel. The substitution of rough rubble for squared work, in conjunction with a flatter slope, permitted a considerable saving to be made.

The embankments have a top width of 14½ft. at 5½ft. above T.W.L., with an outer slope of 2¾ to 1; the inner slope being 2 to 1 to T.W.L., 3 to 1 for 11¼ft. below, changing to 4 to 1, and at 26¼ft. below T.W.L. to 5 to 1. These dimensions were modified where the lining under the inner slopes was of pugged clay, as this generally has more tendency to slip than clay which is worked in place. The inner slopes of the embankments above T.W.L. are faced with concrete blocks cast in place on 6in of gravel on the 2 to 1 slope, and provision has been made for the subsequent erection of an embankment wall of concrete. Below T.W.L. 12in. squared pitching, laid on 6in. of scaplings, covers the 3 to 1 slope, whilst on the 4 to 1 and 5 to 1 slopes the pitching on scaplings is respectively 10in. and 8in. Underneath this stonework there is a 15in. layer of broken stone or gravel, but of increased thickness to form a toe at the base of the embankment.

The top of the puddle wall at 3ft. above T.W.L. is 5ft. wide and each side has a batter of 1 in 12. The selected material consists of silty or inferior clay, whilst the outer parts of the embankments are of fine sand.

There are pillars of dry walling in the outer part of the bank to ensure drainage, but where the subsoil consists of fine sand these pillar drains will probably be redundant. The inlet well is divided into two parts, to one of which one line of 36in. and one of 40in. pipes for Thirlmere water are laid from connections near the Prestwich Reservoirs, and the other is provided for three lines of 36in. pipes from the intended Haweswater Aqueduct. The water from each source is measurable by a rectangular weir and water level recorder.

From the inlet wells into the bottom of the reservoir there is a channel formed of concrete and paved with sets, laid upon the puddle lining. For drawing off the water a

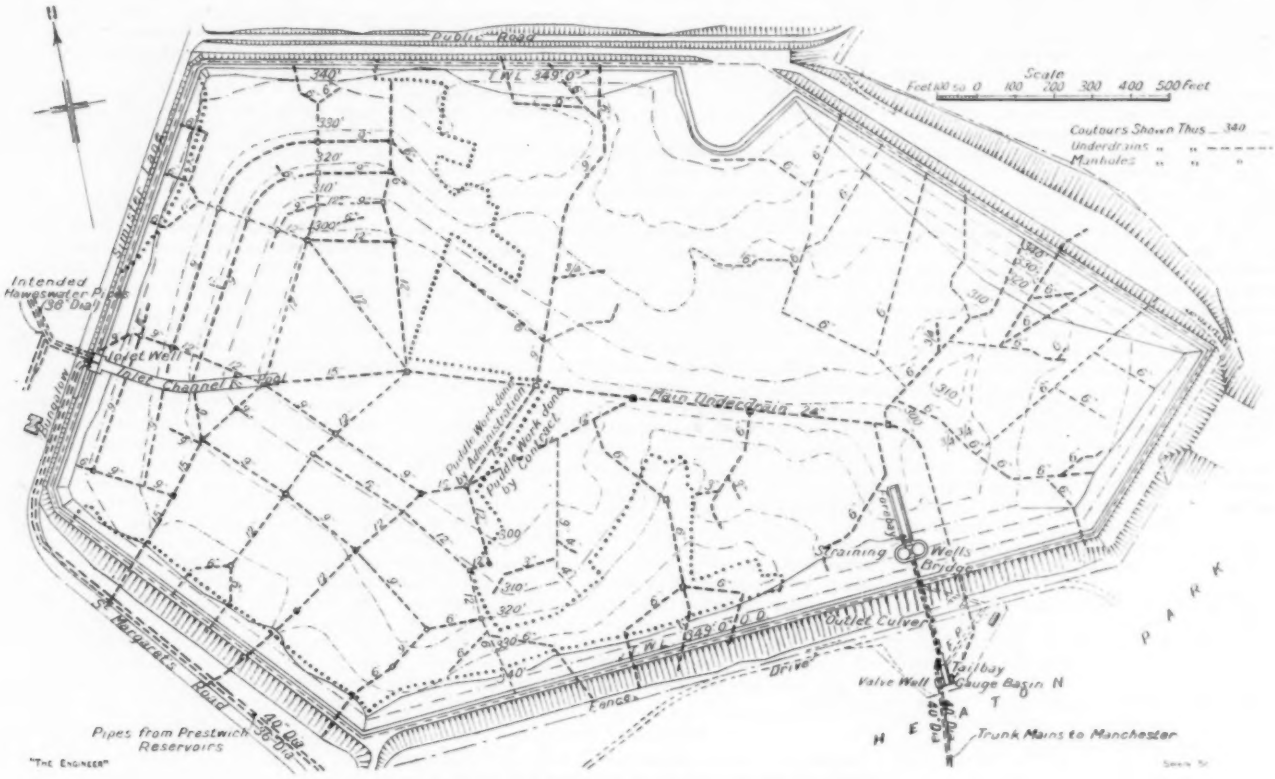


FIG. 1—PLAN OF HEATON PARK SERVICE RESERVOIR

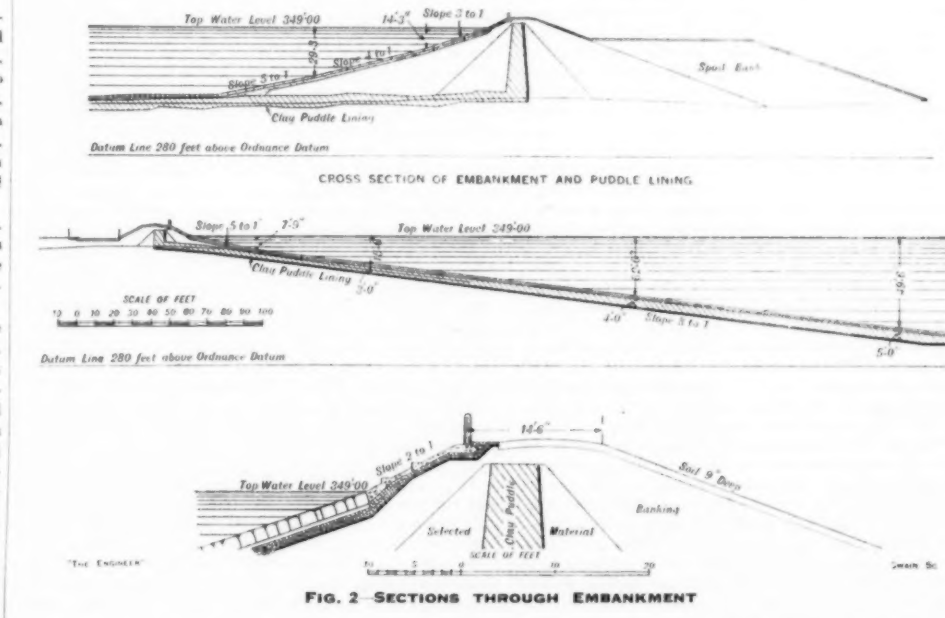


FIG. 2—SECTIONS THROUGH EMBANKMENT

vertical standpipe is provided in the forebay adjoining the straining wells. The standpipe is of cast iron, 57in. diameter, in lengths of 9ft. 11in., and is fitted with mechanism whereby any number of the lengths may be lifted in order to draw off the water at the various levels. From the standpipe the water passes into twin straining wells 30ft. diameter, and after passing the screens enters pipes laid through the outlet tunnel to the city. In the centre of the straining wells a cast iron chamber, 14ft. by 10ft., is provided for screen washing. A 40in. upstand overflow pipe is fixed in a recess between the straining wells, which are built on reinforced concrete piles, are of concrete faced with blue brickwork, and are surmounted by a moulded concrete cope and panelled wall. The outlet tunnel is 13ft. wide and 11ft. high of arched section and built of concrete.

UNDERDRAINS.

In order to prevent the spring and ground water from accumulating under and forcing its way through the puddle lining into the reservoir there is a system of underdrains laid below the puddle lining and discharging into the stream at the tailbay. The construction of the underdrains presented the problem of preventing the fine sand from entering the drains, and of obviating a consequent collapse of the puddle lining. The general principle adopted was analogous to that applied to the construction of a sand filter—the placing of a surround of fine gravel to the drains might be made of large size and might be cleansed at fifteen to twenty-year periods, it did not seem possible to prevent the "ochre" deposits from forming in and sealing the gravel about the drain openings. Continued observations, however, revealed the fact that where "ochre" water was discharged by sand the "ochre" was deposited only upon the surface and not within the sand. The deposition of "ochre" was therefore assumed to be the result of oxidisation or exposure to air, and the conclusion formed was that if certain conditions were copied in the construction of the drains—that is, by keeping the collecting drains and gravel full of water—the latter would be protected against the formation of "ochre" deposits.

Accordingly it was decided to put cast iron weir outlets at the ends of the collecting drains, so as to keep the latter full of water. In order to verify the information, Mr. Harri Heap, M.Sc., F.I.C., of the Public Health Laboratory, Manchester, was asked to make a report, and his conclusions were that the "ochre" deposit was a mixture of iron oxyhydrate and carbonate with hydrated oxide of iron predominating, also negligible traces of calcium. That these insoluble compounds when combined with carbonic acid were soluble, but were deposited whenever the carbonic acid gas was given off, either as a result of exposure to air or a reduction of pressure. The information enables one to understand why the "ochre" deposits were greatest and hardest where the water had its greatest "ochre" to be deposited on the lip of the weir, as is usually the case where such water is being measured. When reviewing the construction of the reservoir the author regards the "ochre" problem as the most difficult one which was met, possibly because it was unexpected, and was outside the general run of engineering work; yet, in the course of time, a fairly simple solution of this problem was discovered. The type of manhole constructed in the underdrains is shown in one of the drawings in Fig. 3. It is expected that the formation of "ochre" deposits will be limited almost entirely to the weir plates and manholes.

Where in wet ground the upper halves of the joints of the collecting drains are not sealed, but are protected by stone and gravel in order to permit drainage of the subsoil, the bases of the manholes are made to project to the extent of 12in., the projections are grooved and the sides are stepped for bonding with the puddle to prevent leakage. The cast iron manhole covers are bedded into cast iron frames with red lead, and to ensure water-tightness there are puddle clay seals, which are protected by a layer of gravel and concrete slabs. Drains from the roads and adjoining area of land are connected to the reservoir underdrains, and the total discharge therefrom is measurable by a V-notch weir at the tailbay. The total discharge is subject to rainfall and dry weather influences, and definite data regarding percolation from the reservoir cannot therefore be obtained, yet the gaugings continue to indicate

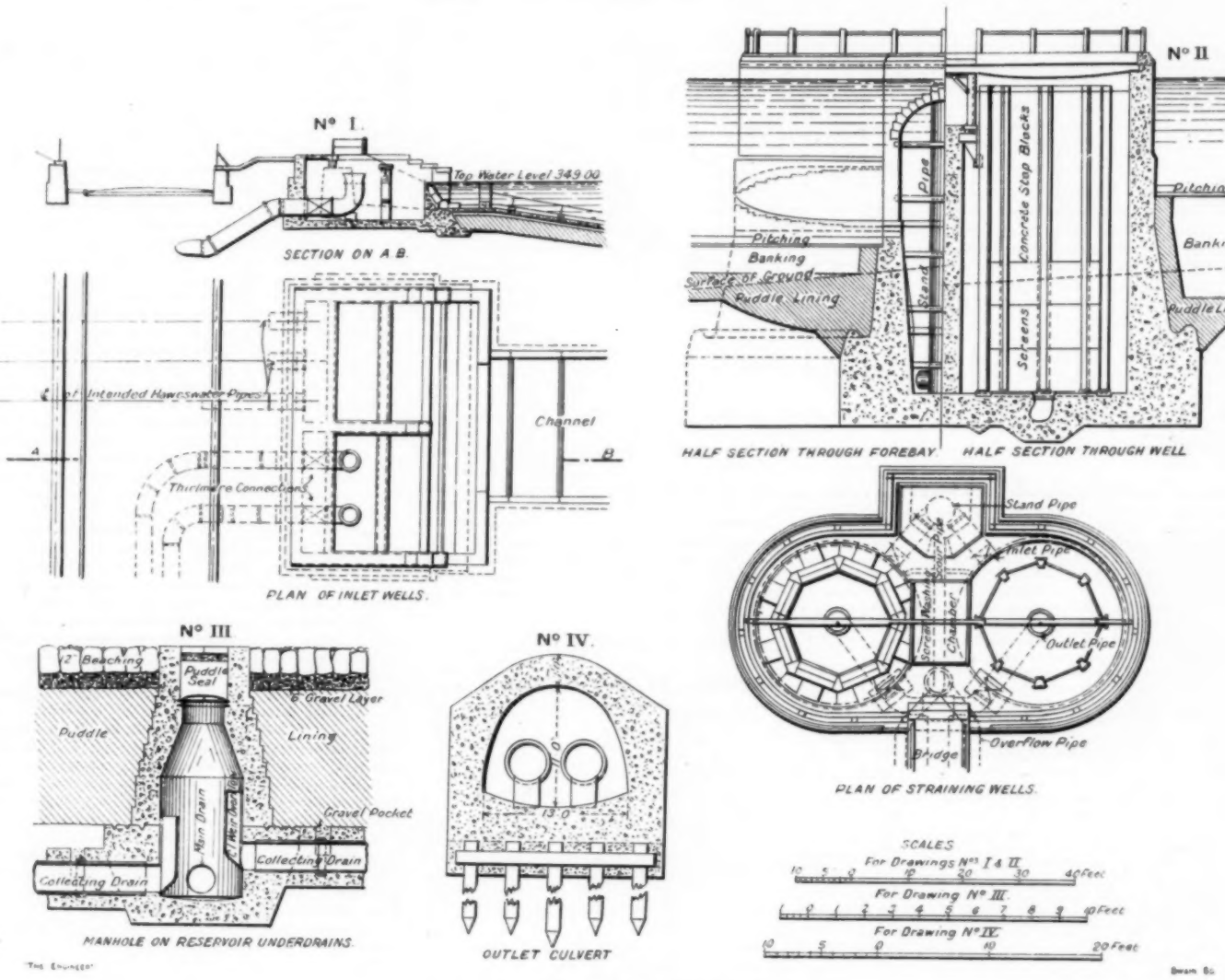


FIG. 3—CONSTRUCTIONAL DETAILS

retain the sand and of larger gravel or stones round the joints and other openings to the drains. Parts of the drains were laid in quicksand formations, and, generally speaking, the work involved constant supervision and not a little anxiety.

The drains laid in the contract period were generally cast iron pipes, 24in. to 3in. in diameter, surrounded by concrete, but small lead pipes were used to tap two small springs whilst small brick and gravel drains were also used. Reflux valves were fitted to all pipes branching from the main drain, no doubt with the intention of localising the damage in the event of the failure of one of the drains.

Shortly after the commencement of the administration period, the formation of "ochre" deposits in the drains was observed. An incompleted 3in. by 3in. brick drain laid by the contractors under an area of puddle lining, was found to contain ¼in. of "ochre," obviously deposited in running water. Further investigation revealed the fact that near the tailbay a 6in. diameter cast iron pipe drain laid at a slope of about 1 in 4, and possibly twelve years old, contained hard "ochre" deposit to a depth of 2¾in.

It therefore appeared that the rate of "ochre" deposit in any of the underdrains might be ¼in. per annum, and that the sealing up of the underdrains was a matter of comparatively few years. The prevention of such deposits was obviously a difficult problem. These circumstances pointed to the advisability of having drains of a much larger diameter than the actual flow of water demanded, and the necessity for manholes to facilitate cleaning.

But yet another problem presented itself, for, although velocity, and were generally of a flocculent nature where the water was sluggish in its movement.

It is presumed that in the adopted system of drainage the chief deposits of "ochre" will occur at the weir outlets in the manholes, which can be cleaned at intervals of years with comparative ease.

The deleterious effect of "ochre" deposits were in greater evidence as time went on and amply justified the assumption that "ochre" deposits were a menace to the safety of the works. A 9in. diameter pipe at the Claylands was found to be so full of "ochre" as to be incapable of passing any water. Many tile drain pipes excavated on the site of the reservoir were similarly choked; the 3in. by 3in. drain already referred to was found to be blocked by "ochre" about 8ft. back from its temporary outlet, whilst its surround of gravel was almost choked by "ochre." An 18in. by 12in. drain of broken stone and gravel nearby was so cemented by "ochre" as to be converted into a weak form of sandstone, and one of the reflux valves taken out to make room for a manhole was so fixed by "ochre" deposit as to prevent it from functioning as a reflux valve.

The question of the advisability of replacing the drains laid during the contract period was considered, but as this work would necessitate a great expense, and as the filling of the reservoir with water might deter the formation of "ochre" deposits, it was decided to leave the matter in abeyance.

The underdrains continue to discharge fine particles of "ochre" in suspension, and there is a tendency for that the puddle lining is standing its test in a very satisfactory manner.

PUDDLE CLAY.

The specification required the clay for puddle to be of the best quality, strong, tough, free from stones and sand, to be laid to form horizontal courses 8in. in thickness, cut lengthwise and crosswise, soaked with water and well trodden so as to work each course into the course below. As there was an insufficiency on the site, provision was made for importing the greater part of the clay required. The clay imported by the contractors was obtained from Moston and Bradford, Manchester, and was of excellent quality. After a small quantity of the puddle lining had been done it was found that whilst it appeared to be satisfactory on and near to the surface, below the surface there were cut marks and spaces which could not be closed by treading or heeling. Apparently as a result of this discovery the maximum depth of the puddle lining was increased from 4ft. to 5ft., and the whole of the puddle clay was required to be put through pug mills.

But another difficulty arose by reason of the pugged clay containing hard nodules, and the contractors were therefore required to dump the pugged clay in heaps in order that the lumps might soften; but this process was later superseded by putting the clay through large runner mills before pugging. These nodules were formed of clay which had been sun-baked, either at the clay pit or in such railway wagons as had stood over week-end periods.

The process of depositing the pugged clay was made more

elaborate than the specification provided for, the depth of the finished layers was reduced to 4in., in place of being "trodden" the puddle layers were required to be "heeled"—the heel marks being required to adjoin one another—to be then "flat-footed" and swept with a stiff brush, whilst the finishing touches to each layer required men with rags and buckets to mop up any slurry on its surface. These departures from the specification not only slowed down the rate of progress, but caused the contractors to make claims for the considerable amount of the extra work done.

The clay used in the administration period from the Corporation Claylands was remarkably pure and extremely tough. It was excavated and filled into "Jubilee" wagons by two No. 6 "Ruston" steam navvies, which did excellent service. There was some difficulty in preventing the navvy from scooping up some of the sand underlying the clay bed, but the amount of sand mixed with the clay was limited to about 10 per cent., and this small percentage, of course, was not apparent after pugging had taken place.

A considerable amount of work required to be done to make good some of the puddle which had been deposited in the contract period. The top of the puddle wall all round the reservoir was found to be badly cracked, and more than one-third of the length where completed was found to be cracked to a depth of from 6ft. to 6½ft. The cracks were plentiful in all directions, but became less numerous as one delved deeper. The main cracks, which extended to the greatest depth, ran across the puddle wall and were fairly regularly spaced from 3ft. to 4ft. apart.

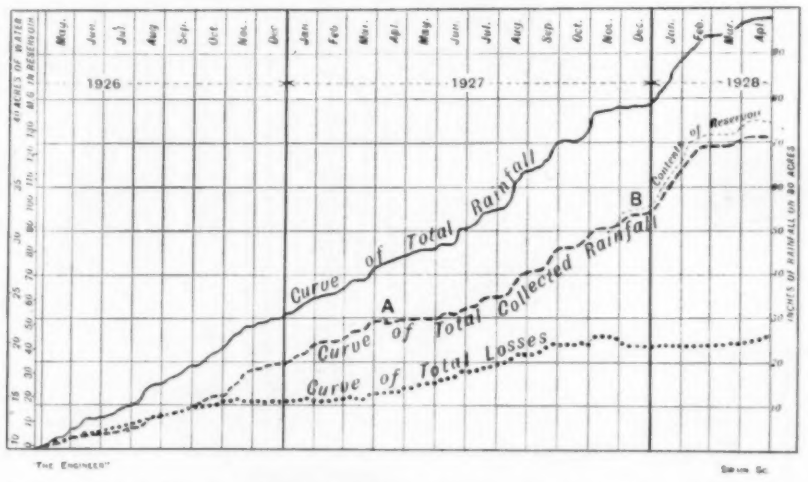


FIG. 4—CURVES SHOWING RAINFALL, WATER COLLECTED IN RESERVOIR AND LOSSES

In the puddle wall excavations a small percentage of the layers showed well-defined cut marks, and this fact emphasises the advisability of using either clay previously worked and exposed or, alternatively, machine-pugged clay, in preference to clay worked solely in place. The amount of puddle clay laid in the contract period and subsequently damaged by cracks was about 10,000 cubic yards, and the cost of excavating and replacing it was about £10,000. The cracks in the puddle in all these cases were due to shrinkage, a consequence of dry winds and continued summer sunshine, the former being practically as injurious as the latter. The use of sacking and coarse canvas, kept wet by means of hose pipes, was effective in preventing the development of cracks in unfinished work, and after the completion of an area of puddle lining the covering layer of gravel or broken stone was deposited without delay. The action of frost caused the puddle to become badly cracked to the depth frozen, which at times slightly exceeded 1ft., and all puddle work was stopped until the puddle had thawed out, generally a matter of seven to ten days. The frost damaged puddle was then made good in place by recutting and reheeling.

Another source of trouble was the growth of *Equisetum* or Mare's Tail, which thrives in damp ground and apparently has a capacity for forcing its hollow roots anywhere within the limit of about 10ft. below the ground level. A strip 6 yards wide of old puddle lining alongside the south bank was found to be riddled with these roots and had to be removed to the spoil tip. To cope with this plant various weed killers were used. Non-poisonous chemicals were applied wherever this weed showed itself in the stonework, and its growth and development were thus prevented. The roots of coltsfoot had penetrated the old clay dumps to a depth of 2ft. to 3ft. and thus rendered a large proportion useless. A gang of half-a-dozen youths and boys was continually employed in weeding from March till October each year.

Filling and Testing the Reservoir.

The reservoir scour valve was shut down in Arpil, 1926, since when the rainfall has steadily accumulated in the reservoir. As a quantitative comparison of the total rainfall with the amount retained is interesting; this is shown by the diagram on Fig. 4. The catchment area of the reservoir has been considered to extend to the centre of the embankments, and measures 80 acres. As there were small gains and losses not measurable, the curves are not absolutely correct, but the limit of error is believed to be less than 1 per cent., *i.e.*, considerably less than the thickness of one of the lines. The fall in the storage curve at (A) was due to 1·4 million gallons being run off.

The dual lines of the curve at (B) show a correction made for inflow due to pipe testing, and the lower branch of the curve shows the net rainfall accumulations. There is a steady increase in the curve of losses between spring and autumn each year, attributable to evaporation, chiefly from the water surface, but also from the remaining area. During the winter months, when evaporation was practically nil, the curve of losses showed no increase, and this feature indicates a very satisfactory absence of leakage from the reservoir. Instead of rising, the loss curve appears to show a slight decline, indicating either small gains from condensation or errors in rainfall gaugings. The small fluctuations of the loss curve in winter are attributed to snowfalls and frosts causing temporary losses, rectified after thawing occurred. In the period covered by the diagram the total rainfall was 97·3in. The quantity of rainfall retained was equivalent to 71·7in. on 80 acres and the losses 25·6in. On April 30th, 1928, the total quantity in the reservoir was 133½ million gallons, the depth being 25ft. and the water area 39½ acres.

Costs.

The amount paid to J. Byrom, Ltd., for about 64 per cent. of the original contract work, extras, plant and materials, was £299,003. The total expenditure by the Corporation during the administrative period has amounted to £330,560. This figure includes the cost of raising the banks and extra drainage work, the cost of repairing the old work, also expenditure on land, buildings and plant, to the value of £8000. Of the total expenditure on the reservoir construction, £295,000 has been spent on scheduled work which would have cost, at the 1907 contract prices, £137,746; that is to say, the administrative work has cost 2·15 times as much as the pre-war contract work. If the increased cost of labour and materials be taken at 2·45 times the pre-war costs, the computed saving in the administrative period would be £41,000.

This figure does not include the saving made by altering the ruling gradient of the puddle lining to permit the substitution of rough rubble pitching for squared work, and which, computed from schedule rates, is £27,500. The computed saving in the cost of the administrative work is attributable largely to the fortunate discovery of clay and gravel near the site, and to the method of depositing the clay puddle in place.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

FIFTY-PERIOD ALTERNATING CURRENT FOR RAILWAY TRACTION.

SIR,—The letter of Capt. Durtnall in your issue of the 27th ult. is somewhat startling. Shocks of the kind are perhaps useful administered occasionally, as tending to jolt the engineering profession out of possible grooves. Not being a "specialist," I can only answer your correspondent in general terms, or, at least, that is all I will be bold enough to venture on.

(A) *Three-phase System Described as Wasteful.*—This is largely a matter of opinion. If we wish to obtain a certain result we may adopt a more costly system for the sake of the resulting practical conveniences resulting. Granted that the single-phase system of transmission is simpler and its control apparatus also simpler and cheaper, or less costly, still that is not all the tale.

In the first place, there is a considerable saving of copper in the line amounting to about 25 per cent., as compared with single-phase, and the wire being thinner, the covering of the wires, when continuous insulation is called for, is also thinner for a given insulation resistance. There results a saving of money overall.

Your correspondent may refer to S. P. Thompson's "Polyphase Electric Current," p. 55, 1895—a very old classic.

(B) *Complexity.*—It is necessary to put up with this feature as payment for other and much more important advantages. Take the case of a large "rotary." Now, whilst it would no doubt be possible as something of the nature of a *tour de force* to convert single-phase alternating into direct current by such a machine, still the rotary would be neither so "efficient" nor as small, and its cost would be much higher than one fed with three-phase, for the reason that at certain regular periods the alternating-current lines are connected direct to the direct-current lines. Thus the converter windings are relieved of the heating effect of current to this extent.

With single-phase there can only be two such direct connections per electrical revolution—or period—but with three-phase there are three such points, and in modern rotaries there are six, since for many years past advantage has been taken of the possibilities of three-phase supply to connect such machines in six-phase.

Capt. Durtnall heads his letter as on railway application, but it really traverses the whole field of electric supply, as I am sure he will admit.

(C) *Industrial Motors.*—If Capt. Durtnall knows any maker of reasonably small or quite small single-phase motors—that is, self-starting, without special windings and not requiring a somewhat elaborate and expensive starting gear—I can only say that I am astonished that such makers do not more extensively advertise their wares.

The three-phase squirrel-cage motor will self start with a simple switch, and even when conditions of supply limit the starting current a star-delta starting switch is usually sufficient and the motor will then start against a moderate load and no special windings are required. On the other hand, if the conditions involve a heavy starting torque we always have the slip-ring type to resort to, which, although more costly than the cage type, is still less costly and complicated than the commutator type.

There is a good deal of difference in running conditions between a 300 horse-power railway motor handled by trained men and a 3 horse-power domestic motor handled by a woman or farm labourer, as Capt. Durtnall will recognise. A system of design fully justified in the former case would be impossible in the second.

(D) *Dangerously High Pressures.*—Are there after all so many deaths due to what may be described as "domestic" supplies, having regard to the number of such supplies? It is well known that "distribution" accounts for quite half the total cost of supply, and the only way in which the size of the feeders and distributors can be reduced is by raising the voltage. Supply voltages of 200–250, of course, involve more danger than supply at 50–100. This danger—in my opinion, it is small—can only be met by better and more trustworthy workmanship and material. It is the price we must pay for lower cost.

Now it happens that a three-phase system not only enables the size and cost of the high-tension feeders to be greatly reduced, but also enables us to obtain two distinct voltages for "domestic" and "power" supplies respectively. Thus we have here a three-phase high-tension feeder to the static transformer kiosks, and a three-phase four-wire distribution, giving 230 volts from phase to neutral and 400 volts between phases for motors. At the same time the whole system stands ready to supply, if required, on six-phase, by very simple and efficient static converters or on single or two-phase by Scott-connected transformers.

Nothing of the sort could be done by single-phase supply, and even if a rectified current were desired nothing even approaching an unvarying direct current could be obtained by rectifying a single-phase supply, whilst by six-phase a sufficiently close approximation could be obtained for most purposes.

I shall not attempt to deal fully with the question of the proper "periodicity" for a heavy railway supply. It is really a specialist's affair. A low periodicity gives rise to less troublesome inductive effects and enables synchronous motors to be designed with fewer poles, therefore less complex and costly and to run at lower speed, and what is lost in larger cost of transformers is partly compensated by lower hysteresis loss in the iron, and the same considerations also apply to a power supply generally.

When, however, we are considering a "general" supply to all and sundry we must give up advantage in one direction to obtain a better result in another quarter. Compromise is called for. Heavy railway supply is sufficient to warrant a separate generating plant on an economical basis, and its separation from a "general" supply removes a probable cause of varying voltage causing jumping lights and sometimes stalled motors.

(E) *Generators.*—There is no question but that a polyphase generator is less costly for equal power output than a single-phase. Little more iron is required, the carcase is not much bigger, and the additional coils occupy space that in the single-phase generator would be idle.

Angmering, Sussex, July 29th. GEO. T. PARDOE.

ELECTRICITY SUPPLY.

SIR,—May I be allowed to draw attention to a few anomalies in connection with electricity supply? Manchester owns the most economically operated supply station in the kingdom, and yet a resident can write to the local paper, pointing out that the charge for lighting there is higher than in other towns where the supply stations do not hold the record for low generating costs. Then, again, the North-East Coast district is stated to have the most up-to-date power stations and system of distribution in the country, upon which the national scheme is said to have been largely modelled. Yet, as a matter of fact, the rate for lighting in Newcastle is 6d. per unit, and that in Manchester is, I understand, 5d. Compared with these, the charge in Birmingham is 4½d., 4d. in other places, and only 3d. in Shrewsbury.

Incidentally, the unfortunate farmers and other people in the neighbourhood of Barton station, and, I understand, other super power stations, are up in arms on account of the damage to the vegetation and personal discomfort resulting from the sulphurous fumes discharged from the chimneys of the power station there. It was ruled that Barton station, being a public utility authorised by Parliament, was privileged to spoil the neighbourhood in this way, as the nuisance is a matter of necessity.

But is such a state of things inevitable? If small stations such as Shrewsbury can supply current at such a low rate as 3d. for lighting and 1d. for small quantities used for power, cooking and heating, and without doing

damage to the countryside, why are such small stations being shut down instead of being encouraged to develop on up-to-date and economical lines, as they should be, so long as they can deliver current at lower rates than the bulk supply stations with their heavy distribution costs and overhead charges supply ?

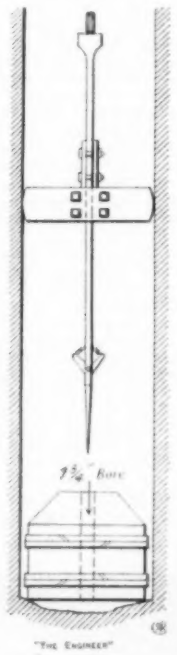
Again, is not the reason why the charge for lighting is so high in some of the towns where the power demand is proportionately large, that the supply stations cut their rates to prevent the installation of independent power plants and endeavour to recoup themselves by overcharging the unfortunate small consumers of current for lighting and other domestic purposes and for power ?

But in the long run economic facts are bound to prevail, and is not a position likely to develop similar to that which obtains at the present time with our railways ? The road vehicles which, like the independent power plants, are free from encumbrances and heavy establishment and distribution charges, are making things very awkward for the railways. SMALL CONSUMER.

July 30th.

RECOVERING BUCKET FROM DEEP WELL.

SIR,—With the possibility that it may be of use to one experiencing a like predicament, I send a description of a method of recovering the vital portion of a deep-well pump. The writer, in charge of a pumping station responsible for a large town's water supply, was called up with the report of a serious breakdown. On examination, it was found that the bottom bucket of a bore-hole pump had sheared nuts and cotter, and owing to no set off, suction piece or foot valve, the bucket was at the bottom of the bore-hole, practically 500ft. below surface. The well, 12ft. diameter, sunk 80ft. with 18in. bore-hole, 420ft. deep with pump 15in. diameter lowered 250ft. in bore-hole.



The length of heavy type of bucket was greater than the diameter ; consequently, it was reasonable to suppose it had submerged perpendicularly. My method of recovery was as follows :—I rigged a gantry directly over the well and rove a flexible steel cable through blocks and falls, bringing down hauling part through snatch block on to drum of winch. I then placed in position a latch board on girders at head of pump delivery, to manipulate 1¼ boring rods, 12ft. lengths, with screwed couplings ; overall length, 500ft. I had a tool made out of 1¼ square mild steel, welded on to boring rod, slotted to take a ratch or barb arrow head, functioned by spiral springs pressing the arrow head outwards. On the tool I had four pieces of timber, 1in. thick, cut just the clearance of diameter of bore-hole, bolted on crosswise to make a guide so that the tool pointed dead centre of diameter of bore.

The first attempt proved a winner. The tool had passed through the 1¾ bore in bucket, the barb had held, and there was the lost bucket in sight. From the time of first length of rod being lowered with tool attachment to having the bucket in hand was just under four hours.

This pump was the main source of supply to a water tower dominating fire and high levels, and as the portion of pump was 250ft. in bore-hole, consisting of 15in. diameter pipes screwed and put together with steel bands and had been in position for sixteen years, one can imagine cost and chaos in supply, especially in case of fire in either drawing rising main or awaiting the manufacture of a new bucket. I enclose rough drawing, showing tool. Possibly you will deem it worthy of publication as a help to others that might be similarly placed.

ARTHUR F. FOWLER.

July 25th.

PADIHAM.

SIR,—The Lancashire Electric Power Company is to be congratulated on its ownership of Padiham Power Station. You, Sir, are to be congratulated on your very full and detailed description of this unique plant, and, above all, on the extensive analysis of the results shown for the first twelve months of the working of the station. These results will be of intense interest to all power station engineers.

The designer and operators of the plant are to be congratulated on achieving such results during the initial year of operation ; surely another unique experience ! Some of the older stations mentioned by name in your leader of July 27th have not yet even eradicated all of what our American friends sometimes refer to as their "Starting up bugs." Padiham seems to have been completely free from these annoying incidents.

Is it not a pity, Sir, that you cannot publish a similar detailed description of the results achieved and the plant conditions obtaining at all or some of the other stations named ? And why not go even further and give the costs, both running and capital charges ; after all, to produce current at the lowest possible figure is the aim of the designers and operators. How informative and controversial such a series would be !

The boiler-house lay-out is against all recognised canons, which appear to prescribe that the plant shall be piled unit upon unit towering into the blue. One of the secrets of the success of Padiham undoubtedly lies in the operation of boilers at a very low rating, burning very good quality fuel. The designer obviously believes that it pays to burn high grade fuel. This belief in itself is something unique.

Can the ideas underlying the Padiham design be applied to stations of upwards of, say, 300,000 kilowatts capacity ? Can the same simplicity of operation be achieved ? It is doubtful.

The description of the methods used to obtain the turbine-house and boiler-house performance figures is very interesting, but will not be altogether to the liking of our friends the instrument manufacturers. The method of calibrating the turbines and using them as their own steam meters was described by Messrs. Otley and Pickles, of the Victoria Falls Power Company, in a paper about 1917, and at that time the method was in use at the Stuart-street Station of the Manchester Corporation, and is still used by the writer. The method is perfectly satisfactory. The maintenance cost of a good water weighing equipment is negligible compared to the cost and trouble of maintaining a host of complicated measuring instruments which are not necessarily accurate even then, and the testing of the turbine at regular periods is good practice.

In your article you state that "The Padiham operating results are so extraordinary that there are people who will receive them with scepticism"—thus at one bound the sponsors of Padiham have joined the all but too small coterie of those whose fate it is to be disbelieved. It is extraordinary the number of people who believe that at, shall we say, Barton ? there is a secret coalfield from whence surreptitious supplies are obtained, or else that the stock books show a wonderful phantom coal stock ! To those who know, this is sometimes humorous but more often aggravating. But it is the ambition of all station engineers sooner or later to join that small but exalted rank.

J. A. VICE.

Upminster, Essex, July 31st.

RAZOR BLADES.

SIR,—I have read with great interest Mr. J. Ferdinand Kayser's article on "The Geometry, Wear and Testing of Safety Razor Blade Edges," which appeared in your issue of June 8th last, and also the correspondence on razor blades which has been published since.

For the last fourteen years I have dispensed altogether with the use of a strop or a hone, the method being based on two well-known physical facts, viz., (1) that a strained plastic metal, if allowed to rest long enough, will become stable again ; (2) that if heated to a moderate temperature, the return to stability is enormously facilitated. A good safety blade will recover its keenness of edge if allowed to rest for about one month.

Personally, I use thirty blades in strict rotation, and for a short time before shaving, during shaving—when soaping the face a second time—and for a short time after shaving, I suspend the blade in hot water—say, at about 75 deg. Cent. or 80 deg. Cent., which is about as hot as one can bear it. The result is I get a clean shave every morning, without stropping, which is bound greatly to prolong the life of the blade. No doubt a few blades—say, five or six—used in rotation would be sufficient. I once as an experiment used a single blade without stropping for forty-two consecutive days with the hot water treatment. The result was perfectly satisfactory.

The same principle should apply to all good razor blades, whether of the safety variety or otherwise. E. HALSE.

July 30th.

SIR,—Will Sir W. A. Tritton try out the following simple rules, which I have found, over a period of years, to give shaving comfort :—

(1) Consider that any well-made razor is capable of giving a good shave.

(2) Keep the strop free from dirt and dust and well lubricated with, at first, some mutton fat, then olive oil.

(3) Occasionally draw the edge of the razor lightly across the edge of the thumb nail. This will give an indication of the state of the edge and at the same time remove ragged edge, if any.

(4) Should the razor or razors become dull, clean and re-lubricate the strop, and well rub with the palm of the hand ; the rubbing should be done daily before stropping.

I think he will find that most razors suffer from over-stropping, especially on dry harsh strops, and the edge will feel rough when drawn across the thumb nail. I use a canvas-leather strop, finishing on the leather side, and never blame the razor, but always deal with the strop if any razors do go off, which is seldom.

London, July 25th. S. H. DE LA MARE.

SIR,—I thank you for your kindness in printing my letter *re* "Razor Blades" in your issue of the 27th, also for your editorial note. I find it difficult to reconcile your view, that razor blades are not to be sharpened—as they are so cheap—with the generally accepted economic facts. Prosperity in any period has always been assisted by economy, which, coupled with progress, has created wealth. The money which would be saved by millions of people by re-sharpening blades would be spent on other goods, and the result would be more comfort, happiness and employment. I recollect the same steel makers who are now making blades approaching me when I controlled one of the largest engineering works in the country to use their new super high-speed drills, their argument rightly being that the work would be done more quickly, that fewer drills would be required, and the public would benefit generally by cheaper production. This is in contradiction to the present advertisements by blade makers advising the public not to sharpen blades, but to throw them away. It would be the same thing if they advised us not to have files re-struck, collars washed, socks darned, &c. It would be excellent for the makers but very poor going for the public.

I shall be much interested to hear the views of many of your readers on this interesting subject.

Woodbridge, July 30th. GREGOR MACGREGOR.

SIR,—Having seen information in your columns recently on safety razor blades, I thought that the following might be of interest. I had six blades in daily use for just over sixteen years. Normally they were stropped every day, and when they needed it I honed them. Possibly on a dozen days—certainly not more—during the sixteen years the razor was not used. This means that on the average each blade was used not less than 960 times.

I still have both the razor and the blades, which were bought in England in 1910 for 5s. My only reason for purchasing a new razor, about two years ago, was that the frame which held the blades was so badly worn that the adjustment of the blade was wrong for shaving and I could not go on using the razor. A. S. L. BARNES.

Toronto, Canada, July 19th.

SIR,—In your note criticising the letter on "Razor Blades" by Gregor MacGregor, July 27th, you say that "Razor blades are so cheap that they could be thrown away when blunt." Assuming they are 4s. 6d. a dozen and one blade last a week, that is an expenditure of 19s. 6d. a year. But how many men can shave twice a day with one blade a week ? Also why should one further the output of a commodity which does not benefit the consumer ? We are rather tired of supporting those who exploit a product which only serves their own pocket and does not help the public. The sharpening of razor blades should be encouraged by all right-minded business men who have any desire to accommodate their customers.

South Farnborough, July 28th. F. M. FINLEY.

THE ROYAL SHOW.

SIR,—It is stated in your report on our engines at the Royal Show that "Engines of the hopper cooled type operating on paraffin were a prominent feature." We wish to say that these engines were running on an English-produced fuel oil from the Hardstoft wells and not on paraffin. They are built to run on the lighter fuel oils or paraffin, but the statement that they were running on paraffin might mislead the reader of the report and give the impression that they only run on that fuel.

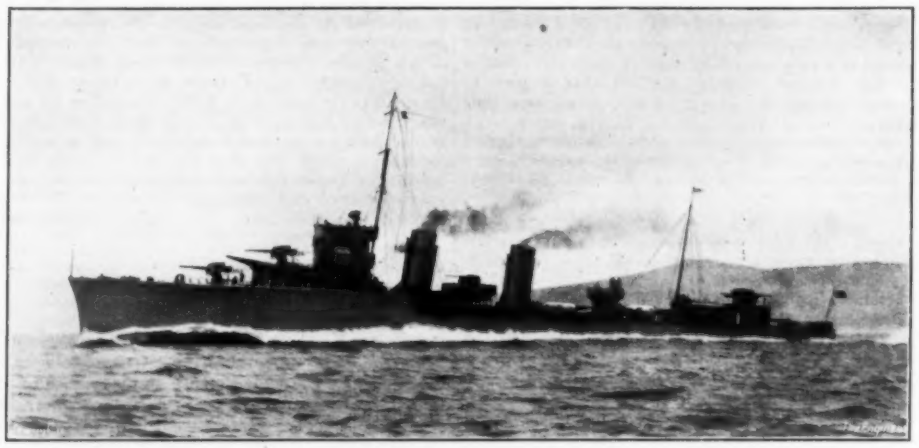
Stamford, July 28th. BLACKSTONE AND CO., LTD.

SIXTY YEARS AGO.

THE parliamentary session which was drawing to its close in July, 1868, was remarkable for the powerful attack made on the Admiralty's policy in the matter of supplying the nation with ships of war. Writing in our issue of July 31st of that year, we recorded that the Lords of the Admiralty were wavering in their faith in the broadside warship to the exclusion of every other type, and that they were enabled to hold together in the face of their foes only by the vigour of Mr. Reed, Chief Naval Constructor, and Admiral Robinson, Controller of the Navy. With everyone outside the Admiralty opposed to the broadside policy, we were convinced that a change would be made and that another session of Parliament would see the construction of turret ships. Opposed, like all others, as we were, to the Admiralty's adherence solely to broadside warships, we took advantage of the occasion to discuss an argument in favour of the broadside ship, to which we said it was foolish to turn a deaf ear. The only good reason, we wrote, which could be urged for confining ourselves to iron-plated broadside ships was simply that monitors—a term then used as practically synonymous with turret ships—could not be rendered comfortable for their crews. It was not too easy at the moment to obtain men for the naval service. It would, we said, be excessively difficult to man such ships as the "Miantonomoh" or the "Dictator"—two United States monitors which had recently greatly impressed naval students. Monitors, we stated, were suitable for coast defence and home service generally, but for long cruises or voyages to distant parts of the world their dark and limited accommodation presented features opposed to the British sailor's notion of a seafaring life. Broadside vessels possessed the advantage in that respect, and it was because of that fact that they were popular with a very large number of naval officers. That fact should not be overlooked. When handled calmly it lost half its force. We argued that there was no reason why we should not have both broadside vessels and monitors, and indeed that our Navy would never be perfect until it was composed of three distinct types of vessel, each intended to discharge a specific duty, namely monitors to defend our coasts, fast unarmoured broadside vessels of considerable tonnage to protect our commerce from rovers of the "Alabama" type, and a third class which in action would essentially be monitors, but which would still possess the power of making long voyages at high speeds and be capable of berthing large crews with

THE CHILIAN DESTROYER SERRANO

JOHN I. THORNYCROFT AND CO., LTD., WOOLSTON, BUILDERS AND ENGINEERS



some comfort. It may be added that in the "Captain," built by Laird's, of Birkenhead, in the following year, the idea embodied in our third suggested type was aimed at, namely, the combination of a low freeboard turret ship with the qualities of a sea-going sailing frigate. That vessel met with disaster. On the night of September 6th, 1870, she capsized with the loss of all but eighteen of the 500 men on board her. Subsequently the design, after being strongly condemned, was fully approved by experience.

The New Chilian Destroyer Serrano.

In the accompanying engraving we show the new Chilian destroyer "Serrano," which returned to Southampton on Monday last, July 30th, after completing successful speed trials on the Skelmorlie measured mile and endurance trials on the return voyage. The "Serrano" is the first of six destroyers which are being built by John I. Thornycroft and Co., Ltd., at Woolston, for the Chilian Navy. The order, which is the largest for torpedo vessels to be placed by a foreign Government with a British firm, was secured in May, 1927, and the builders are to be congratulated in building an entirely new design of destroyer and running the trials within thirteen months of the contract date. Three sister destroyers are also launched, and work is well advanced both on those ships and on the two destroyers still remaining on the stocks.

The "Serrano," which was launched on January 25th, has an overall length of 300ft., with a beam of 29ft., and a maximum draught of about 12ft. 8in. Her fully loaded displacement is approximately 1430 tons. The propelling machinery comprises a twin-screw arrangement of compound geared turbines and geared cruising turbines, with a designed output of over 28,000 S.H.P. The main high-pressure turbines are of the Brown-Curtis type, with low-pressure Parsons cylinders. Steam is raised in oil-fired Thornycroft water-tube boilers, with seamless cylindrical lower drums, and the boilers are designed for a working pressure of 250 lb. per square inch. The guaranteed contract speed of the "Serrano" was 35 knots, and we understand that it was exceeded by a good margin. In general, the trials were most satisfactory. The fuel consumption at full power was particularly good, a figure of less than 1·0 lb. of oil fuel per S.H.P. hour being obtained. Not only was the construction of the hull and machinery most expeditiously carried out, but credit is also due to Messrs. Vickers, who supplied the main armament. This consists of three 4·7in. guns of a new and most efficient design. In addition to these guns, the "Serrano" carries a 3in. anti-aircraft gun and two triple 21in. torpedo tubes. The anti-submarine armament includes mine equipment and Thornycroft depth charge throwers.

EMPLOYEE-DIRECTORS.

To secure the active co-operation of its employees and to enable its staff to obtain a clear idea of the problems that face the management, is a double problem which faces every big industrial firm. In order to meet it, R. A. Lister, Ltd., of Dursley, in Gloucestershire, have adopted a system of employee-directors, which, so far as it has gone, has been highly successful. Six months ago, the firm, in celebration of its diamond jubilee, invited the 1500 employees to elect a works committee to sit with the board. For the purpose of election the works were divided into six more or less equal sections. Some departments were grouped together; others were of sufficient size to make a complete unit in themselves.

Members of this committee have the status of directors. They represent the views of the employees to the other directors, and act as the mouthpiece of the firm in conveying its views to their fellow-workers. The joint board meets once a month to discuss the progress of the firm and the problems of the industry. Any subject which is of interest to the firm or its employees may be brought up by either side, provided it is notified to the secretary seven days before the meeting, so that the necessary information may be prepared in advance and technical experts, if their presence is likely to be helpful, invited to attend. All meetings of the joint board are held out of office hours, and both the directors and the committee members are paid for their attendance at the same rate. Careful minutes are kept of all the meetings, and the employees are kept *au fait* with the activities of the joint board through a works newspaper published monthly.

Though the scheme has been in operation for little more than six months, it has proved of the greatest value. The committee men have been very active in collecting suggestions from their fellow-workers, and a large number of valuable proposals have been obtained for securing greater efficiency of working and an increased output.

This practical co-operation between the firm and its employees is carried a step further in the Social Club run in connection with the company. It is registered as a limited liability company, and its directors are drawn from the ranks of the workpeople themselves. The Club was founded just over a year ago, and as a result of its first year's trading it made a gross profit of over 25 per cent., and declared a dividend of 8 per cent. on all its shares. The club company, which is called "The R. A. Lister Recreation and Social Club, Ltd.," has a capital of £6000 divided into 5s. shares. Membership depends on the holding of at least one preference share. From the point of view both of the firm and of the workers, it has been an unqualified success. It has meant that the men now understand something of the operations of a limited liability company.

An 11,700 B.H.P. Oil Engine for Power Station Work.

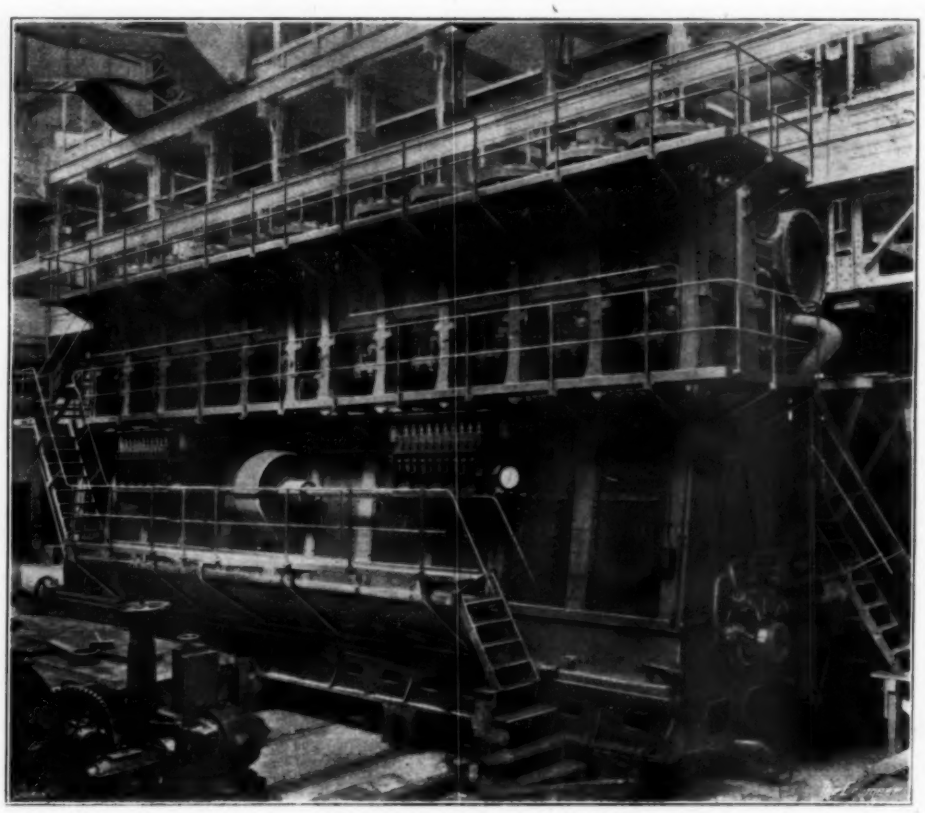
In a paper on high-powered oil engines for peak load service, which was read by Mr. M. Gercke before the Diesel Engine Users Association on May 1st, and was published in abstract form in THE ENGINEER of May 4th, reference was made to the two new 11,700 B.H.P. two-stroke double-acting oil engines, the largest in the world, it is claimed, to operate on the airless injection system, which are being installed in the Maerkische Electricity Works at Berlin. We show in the accompanying engraving the first of these sets which recently underwent successful bench trials at the Augsburg works of the Maschinenfabrik-Augsburg-Nürnberg A.G. (M.A.N.).

The recently introduced modified design of cylinder blocks which gives, it is claimed, a lighter and more accessible cylinder construction has been adopted. Each cylinder casing is made separately, and the units are bolted to each other and to the supporting columns, which, in turn, are secured to the main bed-plate casting. The through-going tie rods on each side of the main bearings are set up with a slight initial tension, so that all the cast iron parts are relieved from the combustion load.

Each of the ten cylinders has a diameter of 600 mm., or about 23⅝in., with a stroke of 900 mm., or say 35⅜in., and the full output of the engine, namely, 11,700 B.H.P., is developed at 215 r.p.m. As will be seen from the engraving, the fuel pumps, which are gear driven from the crank shaft, are arranged on two blocks at the front of the engine. At the right-hand end of the engine, there will be seen the pipe connection from the rotary distributing valve for the starting air.

The generators to which the engine are to be coupled are 6000-volt, direct-current machines, and they are being made by the Siemens-Schuckert Company, of Berlin, while the A.E.G. Company, of Berlin, is supplying the scavenge blowers and as well as the electric motors for driving them.

As the two new units are called upon to function both as peak load sets and standby units, special controls have been designed, which will enable them to be placed in circuit in the shortest possible time.



11,700 B.H.P. DOUBLE-ACTING AIRLESS-INJECTION OIL ENGINE

QUICK MARINE REPAIR WORK.

THE fact that rapid repairs can be made to the underwater parts of ships calling at Cape Town and Durban, at which ports dry-dock accommodation is available, is well illustrated by the case of the German East African liner s.s. "Usaromo," which recently arrived from Southampton with one blade missing from her only propeller. The damage occurred shortly after leaving Southampton, but the ship was held on her course until Las Palmas was reached, where four days were spent in an endeavour to effect repairs. Adequate facilities not being available there, however, the journey to Cape Town was undertaken and completed in the usual running time, whereupon the repair work was entrusted to the engineering firm of Gearings, Ltd. The ship was placed in dry dock on Sunday, June 10th, and after a new blade had been fixed was floated out again the next day. The s.s. "Usaromo" is a ship of 7800 tons, and is one of the largest vessels to have been dry docked for some time.

This, of course, was a small job compared with some of the ship repairs which have been successfully carried out in Cape Town. Among these were the repair of the s.s. "Bhamo," which arrived at Cape Town very seriously damaged through striking a mine off Cape Agulhas. This ship was permanently repaired in Cape Town, and was later used as a transport. Others upon which important repairs have been carried out within more recent years include the s.s. "Gaika," which struck the rocks off Green Point—outside Cape Town—but was able to make the harbour under her own steam; at the same time another vessel ran ashore at Three Anchor Bay—Cape Town—which was subsequently refloated. Another case was the R.M.S. "Saxon," which fouled a lighter in the docks and had a new rudder supplied by a Cape Town engineering firm.

The Institute of Metals.

As previously announced, the autumn meeting of the Institute of Metals will be held at Liverpool from September 4th to 7th next. The following programme has been arranged :—

On Tuesday, September 4th, at 8 p.m., the seventh autumn lecture will be delivered by Mr. F. G. Martin, in the Arts Theatre, the University, Brownlow Hill, the subject being "Non-ferrous Metals in the Shipping Industry."

On the Wednesday, at 10 a.m., there will be a general meeting at the Adelphi Hotel, when a civic welcome will be given to the members by the Lord Mayor of Liverpool, Miss Margaret Beavan. A selection of papers will then be presented in abstract and discussed. For the afternoon the following visits have been arranged :—(*a*) Thos. Bolton and Sons, Ltd., Mersey Copper Works, Widnes, and High Speed Steel Alloys, Ltd., Widnes ; (*b*) British Insulated Cables, Ltd., Prescot ; (*c*) Cammell Laird and Co., shipbuilders, Birkenhead ; (*d*) Lever Brothers, Ltd., Port Sunlight ; (*e*) The Penpoll Tin Smelting Company, Ltd., Bootle ; (*f*) Rylands Bros., Ltd., wire manufacturers, Warrington ; and (*g*) ss. "Oxfordshire," Mortar Mill Quay, Birkenhead, by invitation of Messrs. Bibby Bros. and Co. In the evening, at 7.30 p.m., members and their ladies will assemble at the Adelphi Hotel for an entertainment and dance arranged by the Local Committee.

On the Thursday, at 10 a.m., the general meeting will be continued at the Adelphi Hotel and a selection of papers will be presented in abstract and discussed as time permits. In the afternoon at 2.30 p.m., the party will assemble at the Pier Head and embark on a ferry boat, when, by invitation of the Wallasey Corporation Ferries Committee, a sail on the river Mersey will be made, which will provide an opportunity of viewing the docks, engineering works, &c., on the banks of the river. At 8.30 p.m. there will be a reception at the Town Hall, by invitation of the Lord Mayor of Liverpool, at which the members of the associated learned societies of Liverpool and district will also be present.

On the Friday there is to be a full day's excursion to Bettws-y-Coed and Dolgarrog. Those taking part in the trip will assemble at the Pier Head at 9.45 a.m. and cross the river by the Birkenhead ferry boat leaving at 9.50 a.m.

The following communications are expected to be submitted for discussion :—(1) Dr. C. J. Smithells, S. V. Williams and J. E. Avery, "Laboratory Experiments on High Temperature Resistance Alloys ;" (2) U. R. Evans, "Corrosion at Discontinuities in Metallic Protective Coatings ;" (3) Dr. A. G. C. Gwyer and Messrs. H. W. L. Phillips and L. Mann, "The Constitution of the Alloys of Aluminium with Copper, Silicon and Iron ;" (4) W. R. D. Jones, "The Copper-magnesium Alloys, Part III.;" (5) G. B. Brook and H. J. Simcox, "Note on Practical Pyrometry ;" (6) R. May, "Eighth Report to the Corrosion Research Committee. The Corrosion of Condenser Tubes. 'Impingement Attack,' its Cause and Some Methods of Prevention ;" (7) J. E. Malam, "The Rockwell Hardness Test ;" (8) T. F. Russell, W. E. Goodrich, W. Cross, and (in part) N. P. Allen, "Die Casting Alloys of Low Melting Point ;" (9) F. Hargreaves, "Work Softening of Eutectic Alloys ;" (10) R. Genders, Dr. R. C. Reader, and V. T. S. Foster, "Die Casting of Copper-rich Alloys ;" (11) Dr. C. S. Smith, "The Alpha Phase Boundary of the Copper-silicon System ;" (12) S. L. Archbutt, J. D. Grogan, and Dr. J. W. Jenkin, "Properties and Production of Aluminium Die Castings ;" (13) Dr. W. Hume-Rothery, "Methods for Investigating Alloys of Reactive Metals ;" (14) C. H. M. Jenkins, "The Strength of a Cadmium-zinc and of a Tin-lead Alloy Solder ;" and (15) D. R. Tullis, "Note on the Treatment of Aluminium and Aluminium Alloys with Chlorine."

We are asked to announce that only members, student members and applicants for membership—with their ladies—will be entitled to participate in the Liverpool meeting—except that visitors may attend the reading of papers. For the convenience of applicants for membership who are desirous of attending the meetings, a special election is being arranged in connection with which membership application forms should be received by the Secretary not later than noon on Friday, August 31st, 1928.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

Aid for Iron and Steel.

The announcement of the Government plans for expediting relief to industry has afforded some measure of satisfaction to the iron and steel trades in the Midlands, and perhaps more to the coal trade. The 75 per cent. reduction in local rates paid by railways is to operate from December 1st of this year, instead of waiting until October 1st of next year, when the general derating of productive industry comes in force. The railways, it is specified, must immediately pass on the benefit after December next to industry in the form of lower railway freights for iron, coal and steel, &c. Coal freights are to be lowered only in respect of classes of coal which are of most direct importance in heavy industries, export coal, foreign bunkers, and coal, viz., for use in blast-furnaces and steel works. It is estimated that a total of £4,000,000 will be passed on to the specified interests in a full year as the result of these lower freight charges. It is proposed also to extend the exports credit scheme for a further two years, instead of letting it expire at the end of next year.

Gratification.

General satisfaction with the railway settlement was expressed during the week by industrialists in this area, and by all grades of railwaymen. That it has been possible in face of the many difficulties and complications for the parties concerned to agree in principle upon a 2½ per cent. cut in wages is extremely gratifying, and would suggest that the men are satisfied that real efforts are being made in other directions by the companies to effect economies. The settlement is regarded as the finest possible arrangement. It was stated that the average reduction, taking the top men and the lowest grade, will be 2s. 3d. per week. Broadly speaking, the agreement represents a good bargain for the men.

Business Deferred.

The flat tone in the heavy industries of the Midlands and Staffordshire continues. There is little serious negotiation, and orders are given out sparingly. It is apparent that business of any account will be deferred until after the forthcoming holidays. Stocktaking is engrossing attention in many businesses. Nothing has occurred to disturb the price level in the main branches of the market. There has been a good deal of activity behind the scenes on the agitation for a safeguarding duty. Opinions in the area are somewhat divided, for while the iron and steel makers strongly support the demand, there are numerous trades in which representative men state that any imposition of safeguarding would be a very serious concern, especially for many of the Birmingham industries.

Steel.

The output of steel is in excess of requirements. Structural engineers report better inquiries, and prospects. The seasonal falling off in demand from motor engineering firms is already in evidence, being some weeks earlier than is usually the case. Rolling stock manufacturers have fairly good order books, especially on export account, and orders from this source are fairly regularly received. The continued high prices of continental material improve the chances of home producers in competition with imported steel. Belgian steel bars are now quoted £6 17s. 6d., which brings them within about 10s. of the figure at which consumers can satisfy their requirements under the more advantageous conditions which appertain to buying at home. The difference is about the same in gas strip, for which the British maker wants £7 10s. A fair amount of business is being diverted to home mills. For some time fresh requirements of re-rollers have been met from British mills, some of whom have now very good order books ; but a number of the re-rolling mills in this district are still able to operate as the result of their heavy purchases last October, and that confident buying has been a liberal source of profit in recent months. Mild steel billets continue to be bought fairly freely, and values are maintained at £3 1s. 6d. upwards. Quotations of finished steel are unchanged from last week.

Scrap.

Heavy steel scrap sells freely in Wales at £3 7s. 6d. to £3 10s. per ton delivered. The market has been tightened by the amount of German buying at prices well above those paid by British buyers.

Finished Iron.

There is no new feature in respect of finished iron, the call for which is below normal. A fair amount of business is being done in marked bars, and the basis price of £12 holds good. Crown iron and nut and bolt quality are difficult to sell in large tonnages. The price differences in the former are considerable, the range being from £9 5s. to £10. The nut and bolt trade continues busy, though there is ample room for improvement, and must have material either from Staffordshire or Belgian mills. To some extent steel for these productions is taking the place of iron. A great deal of No. 3 iron continues to come in from Belgium, for nut and bolt and hurdle making. It is obtainable at £6 12s. 6d. Mills at home have no equivalent to offer, and there is no comparability of prices. A good tonnage of strip is being turned out from Staffordshire mills for the manufacture of tubes. A large proportion of the material required by the tube makers, however, is of steel, being cheaper than iron. The Black Country tube trade has been suffering for a long time from the keen competition of the Continent. Orders have fallen off in recent weeks, but, on the other hand, considerable quantities of tubes from abroad continue to come in. Wrought iron gas tube strip makes from £10 15s. to £10 17s. 6d. per ton.

Raw Iron.

The pig iron position remains unchanged, the business with foundries and forges having reached the lowest level for a considerable period. Iron is selling only in small tonnages, and the market is in a mood which may almost be described as passive. The situation has become steadily worse during the past few weeks, and can now only be described as critical. Production continues to exceed demand, and blast-furnacemen are viewing their mounting stocks with grave concern. Fortunately some of the heavy foundries are finding a good demand for rolls from the steel and tin-plate mills, and the makers of cold blast pig iron are able to dispose of their output. The recognised market prices at the moment are £2 15s. 6d. for Northamptonshire No. 3 foundry ; £3 for Derbyshire ; and £3 3s. for North Staffordshire, with 5s. less for forge material.

Galvanised Sheets.

Galvanised corrugated sheets of 24-gauge continue to be based on £13 7s. 6d. Some makers are unable to improve on that, but as much as £13 10s. and £13 15s. is being obtained by a number of mills in the Midlands. Free competition in the lighter gauges of sheets has resulted in a sharp drop in quotations. For some time past this branch of the sheet trade has been subject to price regulation by the general body of manufacturers. External competition in South Wales has become extremely severe, and makers have been forced to retaliate. The basis of £17 15s. for 30-gauge sheets has been cut by at least 10s. per ton. Heavier cuts are spoken of, but the position has not yet solidified.

Midlands Electrical Development.

The annual report of the South-West Midlands Advisory Joint Committee (Electricity Supply), recently rendered to the Electricity Commissioners, shows that considerable progress has been made during the year, some twenty small towns and villages in Worcestershire and Warwickshire having been afforded supplies where previously they were not available. There has been an increase of 21 per cent. in the number of electricity consumers and a 20 per cent. increase in the total quantity of current sold. There has been, it is stated, a 17½ per cent. lower consumption of fuel per unit of electricity generated.

Wolverhampton Transport Scheme.

The Transport Committee of the Wolverhampton Corporation proposes to complete the purchase of tramways and light railways, &c., from the British Electric Traction Company, Ltd., the Wolverhampton District Electric Tramways, Ltd., the South Staffordshire Tramways Company, and (Lessee) Company, Ltd., for £26,500, subject to the Corporation Bill of 1928 receiving the Royal Assent. A decision to run trolley omnibuses on several routes at present served by tramways will mean the disappearance of the last of the trams from the Wolverhampton transport area. A new omnibus garage is to be erected, at a cost of £20,965, while new vehicles to be purchased include six double-decked six-wheeled omnibuses at £2015 each, two single-deckers at £1425 each, and two twenty-seaters at £630 each, all from Guy Motors, Ltd. Two canal bridges in Bilston-street and Horseley Fields are to be taken over, while the London, Midland and Scottish Railway bridge in Cannock-road is to be reconstructed, and the road widened to 50ft., at a cost of £15,800, subject to a grant from the Ministry of Transport.

Proposed New Bridge.

The Staffordshire County Council on Saturday last decided, owing to the serious condition of a bridge at Weston Coyney, to erect a new structure, with concrete abutments and steel decking, at an estimated cost of £900.

Rolling Stock Contract.

The Metropolitan Carriage Wagon and Finance Company, Ltd., of Saltley, Birmingham, has secured a contract for thirty motor bogie first-class coaches for the Central Argentine Railway. The rolling stock is required for the electrified suburban lines round Buenos Ayres.

Workless.

Following upon last week's increase of 5418 in the number of unemployed in the Midlands is one this week of 4359. The total for the area has now passed the two hundred thousand mark, being 202,909. Of these 96,609 are said to be only temporarily "stood off," or on short time. The Birmingham figure now stands at 31,677 and Coventry's unemployed total 7208.

LANCASHIRE.

(*From our own Correspondents.*)

MANCHESTER.

Railway Shopmen and the Agreement.

It is difficult at the moment of writing to gauge the attitude of railway workers in this centre towards the provisional wages agreement reached between the railway managers and the officials of the three trade unions concerned. If one may judge from a semi-official statement made during the last day or two, a good deal of opposition to the agreement from the lower-paid workers in this area will be expressed at the special delegate meeting, though it is believed that the railway shopmen, mainly because of the prospect of increased work, will be in favour of acceptance. Manchester is, of course, an important railway engineering centre, large numbers of shopmen being employed at the locomotive works at Gorton and Newton Heath. The Crewe and Horwich works and the carriage and wagon works at Dukinfield are also included in the Manchester area.

Canal Bridges of Long Ago.

The inadequacy of many of the canal bridges in the city area to the needs of modern transport is causing some anxiety in Manchester official quarters. Mr. J. B. L. Meek, the city engineer, says that many of the bridges were constructed about 150 years ago, and are incapable of carrying with safety the weight of modern traffic. It has been decided to rebuild them all as soon as possible, and the necessary steps are being taken to secure Corporation control from the canal companies which own them. Terms have been agreed between the Rochdale Canal Company and the Manchester Corporation, under which the company has paid the Corporation an agreed sum to take over its obligation, and steps are being taken to secure, if possible, similar arrangements with other canal companies in the area. Work has already begun on the rebuilding of one of the Rochdale Canal Company's old bridges in Manchester, and several other bridges in the city will be similarly treated within the next few months.

Diesel-electric Locomotive Trials.

Service trials with a Diesel-electric train unit are being made by the London, Midland and Scottish Railway Company between Blackpool and Lytham. The power unit of the train, which is one of four coaches, consists of an oil engine driving generators for the supply of current to the motors. It is claimed that the train shows increased acceleration, with, in addition, all the advantages of being a self-contained unit. The demonstration is being carried out by William Beardmore and Co., Ltd.

Transporting a Railway Coach.

A railway coach for Newfoundland, 63ft. in length and weighing 19¼ tons, was carried last Saturday over the London, Midland and Scottish Railway Company's system from the Nottingham works of Cammell Laird and Co., Ltd., to Liverpool docks, for shipment on the following day. The coach was carried on two specially fitted trolleys.

Air Port for Liverpool ?

Important air port developments at Liverpool are foreshadowed by the recommendation of the Finance Committee to the City Council to purchase for the sum of £200,000 an estate at Speke of 2200 acres. The land is situated at the south end of the city, with a frontage to the river Mersey, and the proposal is to utilise a portion of the estate for the construction of a first-class air port.

Non-ferrous Metals.

There has been nothing spectacular about any section of the non-ferrous metals market this week. Supplies of tin on most days have proved more than sufficient to meet the demand for the metal, and quotations have given way in consequence. Values current at the time of writing are still rather better than they were a fortnight ago. On balance, however, there has been a loss on the week of between £3 and £4 a ton, with a resultant check to what appeared to be a steady, if slow, recovery from the low prices that were current at the beginning of July. With buyers in the copper section adopting a cautious attitude, actual business during the past week has been on somewhat narrow lines, and in standard brands values have given way to the extent of about half-a-crown a ton, though refined descriptions of the metal have continued firm. There has been a fair demand for lead, and as supplies of this metal have not been excessive, there has been a slight firming up, current values being about the highest quoted since the middle of June. More or less similar conditions have obtained in respect of spelter, and here, too, prices are fractionally higher than they were a week ago.

Iron.

Sellers of pig iron on this market appear to be fully resigned to a continuance of inactive conditions for the next three or four weeks at all events. A number of foundries will be wholly or partially closed next week, and, on the whole, this has reacted on the market for pig iron. Occasionally, one meets with a seller who has been fortunate in securing a bigger volume of business than has been the usual experience during the past few months, although, as before, there seems to be a disinclination to enter into forward contracts of any weight for the time being. In any event, however, buying generally has been poor, and Midland producers may be considered fortunate in having been able to resist attempts to bring prices down further. Offers for delivery to Manchester or equal have varied between 67s. 6d. and 68s. per ton for Staffordshire and Derbyshire brands of iron, with Middlesbrough makes still quoted at 79s., Scottish at between 87s. 6d. and 90s., and hematite at about 82s., all delivered to works in this district. The movement of manufactured iron is about up to its recent level, with Lancashire Crown bars quoted at £10 and second quality material at 10s. per ton less.

Steel.

Conditions in the steel market also are to some extent of a patchy character. Whilst there are isolated instances of rollers who report a satisfactory improvement both in the number and the size of orders, most firms continue to experience a quiet demand, whilst pretty well all of them are still able to furnish what is virtually prompt delivery of most kinds of material. As to prices, there has been very little change so far as British products are concerned. The majority of re-rollers are maintaining their quotation of £7 15s. per ton for small bars, whilst large bars are held for £8 17s. 6d., with joists and sections at £7 17s. 6d., frame and general plates at £8 12s. 6d. to £8 17s. 6d., and boiler plates at £9 10s. to £9 15s., according to quality. There is still a conspicuous absence of any big buying in the continental steel section, and most of the business that is being placed here just now is for small parcels. Continental mills, however, are well situated on orders from other sources, and a further firming up has occurred during the past week, billets for delivery to Lancashire works being quoted at about £5 10s. per ton, sheet bars at £5 12s. 6d., Siemens plates at £8 to £8 2s. 6d., wire rods at £6 15s. to £6 17s. 6d., angles at £6 13s. 6d., joists at £6 to £6 2s. 6d., and Belgian bar iron at £6 15s. per ton.

BARROW-IN-FURNESS.

Hematites.

Business in West Coast iron remains very quiet. The wants of users on general home account are limited in volume, and a hand-to-mouth trade only is being done. Workington steel makers have fair requirements, but Barrow steel makers are still out of the market for iron and local founders' wants are light. Overseas trade is dull and confined to small parcels of special iron for the Continent. There are eleven furnaces operating, and more iron is being produced than can be sold, and in some cases quite large tonnages are held in stock. There are no signs of any betterment in the immediate future.

Iron Ore.

The call for hematite iron ore is fairly good, so far as local smelters are concerned, and best grade ores are going to the East Coast from Cumberland. The importations of foreign ore are dull just now.

Steel.

The activity in the steel trade is mostly confined to the Workington district, where the rail mills are engaged, but at Barrow the whole of the plant is idle with the exception of the hoop mills, which are engaged on orders for overseas and the demand is maintained. Rails are quiet, both on home and overseas account.

Fuel.

For fuel there is a steady call, both steam coal and coke. The East Coast provides the bulk of the coke supplies.

SHEFFIELD.

(From our own Correspondent.)

A Quiet Period.

THE longed-for signs of improvement in the iron and steel industries of the country do not yet manifest themselves, but, on the contrary, the position continues to deteriorate, and Sheffield, in common with other centres, is finding its activity declining. There is, it is true, a large amount of work on hand, but it is not by any means large enough to provide good employment for the city's great plants, on either the heavy or the light sides. Less than half of the open-hearth furnace capacity of the city is in operation at present, and, with regard to all the chief Sheffield products, it is declared that both output and turnover are below the level of a year ago. Slackness in a number of trades which normally call for large quantities of Sheffield steel is causing a falling off in their demands. The railway companies, for example, are not placing orders of average bulk, while the demands of the shipyards show a falling tendency, and trade in colliery requirements is very poor indeed. Owing to the holiday season, many buyers are away, and stocktaking is taking place at many works which consume Sheffield products; hence there is no probability of a spurt in trade at present. The reports of heavy orders placed during the past week include some secured by Cammell Laird and Co., Ltd. This company has booked, for its Birkenhead yard, an order from Elders and Fyffes, London, for two large passenger and fruit-carrying steamers for service between the West Indies, Central America, and this country. These vessels will be similar to the "Tilapa" and "Samala," which were recently completed at Birkenhead for the same owners. Messrs. Cammell have also received at their Nottingham establishment an order from the Central Argentine Railway for thirteen first-class trailer coaches and six second-class trailer coaches.

The Lighter Trades.

It is pleasant to be able to report progress in one industry at any rate. This is the manufacture of hack saw blades, which continues to expand at a satisfactory rate. These blades were originally made in America, and twenty years ago that country supplied four-fifths of the quantity used here, the remainder being of Sheffield make. Now, Sheffield leads, in about the same proportion. Ten firms in the city are making the blades, which compete successfully with those of the United States in both quality and price. Not long ago Sheffield introduced a hack-saw of high-speed steel, and the demand for this is growing rapidly. There has been a fairly satisfactory sale of farm and garden tools during the season. Most branches of the tool trade report a quiet time at home, and only a moderately good export demand. Substantial contracts for cutlery, spoons, and forks, for the furnishing of hotels and steamships, have been rather plentiful of late, but a falling off in this respect is now reported. The ordinary demand for cutlery of good quality is slow, but a fair amount of business continues to come forward in the cheapest lines. The export trade in cutlery and plate remains at about recent levels.

Stainless Steel Progress.

The prospect of a large use of stainless steel for ship fittings, as a substitute for brass, is opened up by the report of a successful test of a stainless steel plate which has just been carried out at sea. The plate has been on the liner "Arandora" on a six weeks' voyage to South America and back, a distance of over £13,000 miles, and during that period it has been exposed on the promenade deck of the vessel in order to test its behaviour under the action of sea air and salt water. The plate has not been cleaned in any way. The vessel has now returned to London, where an official commenting on the results of the test, said that they were very satisfactory. The metal showed no signs of tarnish and was as bright as when originally placed in position. Another item of stainless steel interest is the fact that the great chain of that material, made by Brown Bayley's Steel Works, Ltd., Sheffield, for the strengthening of the dome of St. Paul's, was despatched from the city last week. The chain is the largest of its kind ever made. It is 450ft. long and weighs 80 tons.

Coal-working Facilities.

The colliery companies of this district continue to avail themselves of the Mines (Working Facilities and Support) Acts, in order to develop small scattered coal areas. The latest proposal under the Acts is one by the Cortonwood Collieries Company, Ltd., which has given notice of its intention to apply for an order granting it the right to work the Parkgate, Swallowwood, Silkstone, and all other seams, except the Barnsley, which lie below the depth of 300ft. under lands in Brampton Bierlow, West Melton, Wombwell, and Wath-upon-Dearne, in South Yorkshire. The total area of the land affected by the application is 178 acres.

A Successful Exhibition.

It is gratifying to know that the Exhibition of Sheffield Workmanship, which was held at the Cutlers' Hall last month was not only highly instructive, but also a financial success. The total attendance was upwards of 20,000; 10,000 tickets were disposed of before the Exhibition, 7000 were sold at the door, and nearly 4000 school children were admitted free. The Chamber of Commerce, which was responsible for the finances of the Exhibition, is retaining the credit balance for such purposes as may be decided later, when the whole question as to the holding of further exhibitions in other parts of the country has been carefully considered. In order to deal with the future of the Exhibition and any similar project for the furtherance of Sheffield trade, a special committee is to be set up by the Chamber of Commerce in co-operation with the Cutlers' Company.

Electricity Progress.

The municipal electricity undertaking of Sheffield is a very progressive branch of the City Council's work, and is able to report a large measure of success for the year ended March last. Thirty years ago, when the department was municipalised, it sold less than 1,000,000 units. Before last year, it reached its highest activity during the war, its record for the period ending March, 1918, being 172,451,007 units. In 1927 it nearly equalled that figure, the difference being the comparatively small one of about 2,000,000 units. Last year it eclipsed all previous figures, having a total sale of no less than 198,228,994 units, showing an increase on the previous twelve months of 28,015,581 units. The total number of consumers is now 47,521, an increase for the year of 8286, or 21 per cent.; and the total connections now amount to 269,255 kilowatts, an increase of 10,639 kilowatts. The credit balance for the past year amounts to £238,453, as compared with a debit balance of £52,521 in 1927. The sum of £8978 is to be transferred to the relief of rates, £17,101 to the reserve fund, and £131,856 is to be applied to the clearing off of the debit balance for 1927. The average price obtained for current during the past year was 2·174d. for light and heat, and 0·843d. for power, or a total average of 1·113d.

By-pass Canal at Leeds.

A by-pass canal, consisting of a siding cut from the Leeds and Liverpool Canal, has been constructed at Redcote, in order to facilitate the delivery of fuel to the super-power station which the Leeds Corporation is erecting at Kirkstall. The cut is 300 yards long and 50ft. wide, and will enable barges to leave the canal, unload coal at the generating station, and then return to the canal. Fifteen barges can be unloaded at the wharf at the same time, and a supply of about 1000 tons of coal per day is assured. The by-pass is a special construction of concrete. It has been built by Wellerman Brothers, of Sheffield, and has cost about £20,000.

A Large Municipal Scheme.

A scheme of exceptional magnitude has been adopted by Nottingham City Council, which has decided to undertake a new main drainage system, at an estimated cost of £750,000. The construction and cost will be spread over a period of years. The existing sewage system was laid down more than fifty years ago, and owing to the growth of the city has become inadequate.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Trade Outlook.

THE outlook in the Northern iron and steel trade at the moment cannot be described as otherwise than gloomy and discouraging, though hope of trade revival in the autumn has not been altogether abandoned. More plant is being laid idle, and fear is expressed that the worst of the depression has not yet been experienced; but while contracts in hand are fast expiring, and orders to follow on are not coming forward, some work, execution of which was necessarily delayed, will be resumed this month. Seasonal quietness is more pronounced than usual, and any market activity is not looked for until the beginning of September, when in the ordinary course negotiations to cover fall of the year requirements should open out. In the meantime only unexpected expansion of prompt demand can justify manufacturers in maintaining output. The parlous condition of the pig iron trade is further emphasised by the putting out of blast of another furnace by Dorman, Long and Co., Ltd., Middlesbrough. The plant affected is the Newport Works, where a furnace engaged on hematite pig iron has been blown out. Of the 95 blast-furnaces on the North-East Coast, the number in operation is 29, of which eight are making Cleveland pig iron, six hematite, 13 basic, and two other kinds of iron. The two furnaces at the Tees Ironworks of Pease and Partners, Ltd., Middlesbrough, discontinued making iron during the week-end.

Cleveland Iron Trade.

The position as regards Cleveland pig iron shows no change Business continues extremely quiet, makers refusing to meet customers' claim for price concessions, and intimating that, if orders are unobtainable at present unprofitable rates, they will be compelled to put more furnaces out of blast. Supply is not at all plentiful, stocks being low, and needs of producers' own consuming plant, together with deliveries against running contracts, almost absorb the restricted output. The small surplus available for the open market is fairly well disposed of. Fixed market quotations remain:—No. 1 grade of iron, 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; and No. 4 forge, 64s. 6d.

Hematite Pig Iron.

In the East Coast hematite pig iron trade makers are hampered by rather large stocks, and though they are disposed to take a slightly firmer stand in regard to prices, they are still unable to secure anything like remunerative terms, and buyers report that they experience no difficulty in picking up cheap parcels. While there are next to no sales of ordinary numbers, quotations for Nos. 1, 2 and 3 continue to rule values of special brands. Consumers are purchasing little other than iron made to analysis. Certain producers quote on the basis of 70s. for mixed

numbers, but buyers state they can purchase at round about the equivalent of 68s.

Ironmaking Materials.

The foreign ore trade is without new feature. Merchants, confident of an upward movement in prices, advise arrangement of contracts, but fail to induce consumers to resume negotiations for supplies. Best Rubio ore is firm at 22s. 6d. per ton c.i.f. Tees. Coke is well sold for export over the next few months, but demand for local use keeps very quiet. Good medium furnace kinds are 17s. 6d. to 17s. 9d. per ton delivered at the works.

Manufactured Iron and Steel.

A good deal of work has still to be executed in the manufactured iron and steel trade, but orders for several descriptions are essential if plant is to be kept in operation until the commencement of the autumn demand. Producers of shipbuilding material and of railway requisites need specifications, but manufacturers of structural steel are fairly well employed, while sheet makers are heavily sold to the end of the year. Prices are unchanged.

Coal Freight Relief.

The ordinary run of the Northern coal trade during the past few days has been upset by the uncertainty as to the Government's proposals, and matters are expected to remain quiet for some weeks. A question which is exercising the minds of coalowners and exporters is whether the relief on coal freights will be at a flat rate or in proportion to the present rates paid. To the various districts a great deal depends upon the method chosen. In Northumberland and Durham, for instance, the average "lead" is 2s., whereas in Yorkshire it is 5s. 6d. If a flat rate of, say, 9d. a ton were allowed, each district would benefit to the same extent; whereas if relief at the rate of 25 per cent. on the present basis were accorded, the average benefit to Northumberland and Durham would be 6d. a ton and to Yorkshire 1s. 4½d. As freightage has always entered more largely into the f.o.b. price of Yorkshire coal than of the Northumberland and Durham product, a case can no doubt be made out for the proportional easing of the burden. On the other hand, the older pits of Northumberland and Durham have the disadvantage of more expensive working than those of Yorkshire, a burden from which there is no relief. Thus, while among the various districts freightage is not the only burden which weighs disproportionately on total costs, relief is being concentrated in this direction, so that the most equitable method of granting relief would not necessarily be a proportionate reduction of railway rates, though it would unquestionably be the most simple plan to operate.

The Coal Market.

There has been no special development in the Northern coal market. New business is scarce and fitters in all descriptions find the outlook irregular. Buyers have shown a disposition to leave forward business severely alone since the announcement of the Government's intentions regarding coal transport relief, and now everybody is waiting to hear more of the scheme. Meanwhile, sellers are firmly keeping to the old quotations, and have to be satisfied with a hand-to-mouth trade. The steam collieries appear to have enough orders to carry on as they have have been doing lately, but extra orders would be welcome. Best Northumberland steams are quoted at 13s. 6d.; and best Durham steams 15s. to 15s. 3d. The offering of small steams is rather restricted, and prices of those are steady at 9s. 3d. to 9s. 6d. Supplies of Durham gas coal are abundant, and the pits are working only irregularly, but prices are not being discounted. Best qualities remain at 14s. 9d., and secondary sorts at 13s. to 13s. 6d. There is a good deal of coke to be shipped, but boats are not in adequate supply, and the prompt position is consequently only quiet. Definite demand is on the slow side, but there remains an active forward inquiry, and sellers ask firm prices for loadings later in the year. Gas coke is 20s. to 20s. 6d.; patent oven coke, 18s. to 18s. 9d.; beehive coke, 23s. to 27s.; special foundry, 22s. to 24s.

Order for Cargo Ships.

An order for three cargo steamers has been received by W. Gray and Co., Ltd., West Hartlepool, from a Spanish firm of owners to be used for a service between England and Spain. The vessels, which will be of 2000 tons deadweight each, will be built at the Central Shipyard, West Hartlepool, and engined at the firm's Central Marine engine works.

SCOTLAND.

(From our own Correspondent.)

Quiet Restart.

OWING to the state of trade in general, the holiday season has been unduly prolonged, and while the majority of the works are again in operation, some are still idle. On the whole, the restart has been quiet, and the general outlook has not improved.

Steel and Iron.

So far as can be ascertained, the amount of business in steel and iron which has accumulated during the vacation is not particularly large, and the outlook for the immediate future is not satisfactory. The state of the shipbuilding industry does not hold out any promise of increased demands for heavy steel, while foreign competition continues to play havoc with the bar iron and re-rolled steel trades. Heavy sheets also are disappointing, and while the light varieties are somewhat better off, the volume of business in the latter is not too convincing. Galvanised sheets have a moderate turnover, and with a somewhat better inquiry on export account, corrugated sheets, 24 g., are quoted £13 7s. 6d. f.o.b. Glasgow. There are only some seventeen pig iron furnaces in blast in Scotland, and it may be some time before the number is added to, owing to poor demands and the inadequate prices realised. The drop in prices realised means lower wages for the workers engaged.

Exports and Imports.

Owing to the holidays, traffic has been comparatively light throughout the past week, when 2450 tons of iron ore and 2700 tons of iron and steel products were dealt with. Exports of steel and iron amounted to 3500 tons, and were dispatched to the Colonies, Spain, the Mediterranean, England, and Ireland. Pig iron shipments amounted to 452 tons, compared with 916 tons last week.

Coal.

The Scottish coal market has not yet recovered from the effect of the holidays. Business in all branches has been quiet, and buyers show no inclination to anticipate their requirements. Shipping demands have been conspicuous by absence, and prices have not been tested. Home demands are well below normal. Meanwhile, the collieries are chiefly engaged fulfilling orders held up by the holidays, and some demand by shippers for fuel against contract. Lanarkshire splints and ells, especially the former, are well taken up, and Fifeshire collieries have a ready outlet for first-class steams. Washed nuts are still very scarce. Shipments for the week amounted to 204,649 tons, against 99,282 tons in the preceding week and 189,650 tons in the same week last year. The collieries in the Lothians were on holiday last week.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Relief.

THE decision of the Government to expedite its coal relief measures so as to operate as from December 1st is satisfactory up to a point, but there is no disguising the fact that the announcement was received with feelings of disappointment in coal-owing and exporting circles last week, as it was expected that the Government, recognising the urgency of the coal trade's needs, would by some means have made its proposals to apply immediately. The question is whether many undertakings can keep going until the end of the year under the prevailing conditions, seeing that the prices obtainable for their coals are quite unremunerative. Still half a loaf is better than nothing at all. How the impression has got about, it is difficult to say, but it appears that in some quarters there exists the idea that as the result of the Government assistance there will be a fall in coal prices. This was the case when the Government last granted a subsidy to the industry for the maintenance of wages. The foreign buyer certainly reaped the benefit in the shape of reduced prices, but there is no doubt that on this occasion steps will be taken to prevent this happening. The position is altogether too serious. Mr. Finlay Gibson, the secretary of the South Wales Coalowners' Association, has stated that the members of that body will definitely retain what financial benefit may accrue from the Government proposals, and has pointed out that the recent losses in South Wales have on the average ranged from 1s. 3d. to 1s. 6d. per ton, and accepting Mr. Churchill's estimate that the relief would amount to something like 7½d. per ton, such a saving would be less than half the loss per ton suffered in this district.

Dry Docks and De-rating.

Satisfaction is felt in this district, which is one of the most important ship-repairing areas in the country, with the announcement made in Parliament last week that this industry will come within the scope of the Government scheme for the remission of 75 per cent. of local rates. Doubts appear to have existed whether the ship-repairing industry would be covered, but an announcement was made by the Minister of Health in reply to a specific question from one of Cardiff's representatives in the House, which forms a definite assurance that the industry will receive the full benefit of the de-rating scheme. It is a very important matter, as in the case of one undertaking alone, it is estimated that the amount that will be saved, based on the burden of local taxation, will be round about £3000 per annum.

Coal Trade Conditions.

There has been no appreciable change in the general conditions prevailing in the coal trade. There is nothing in the nature of a pre-holiday rush for coals, as there is no pressure at any of the local docks. Last week's shipments were just over 450,000 tons, which was practically the total of the previous week. The trouble all round has been the shortage of prompt tonnage, and not so much the absence of orders, though, of course, the latter are quite inadequate to put life into the industry. At the end of last week there were thirty-nine idle tipping appliances at the various docks in South Wales, and arrivals over the week-end were not so numerous as to cause activity of a pronounced character. On Monday there were still twenty-nine idle tipping appliances, so that it will be gathered that the position this week has not been as satisfactory as might be desired. The general demand, both for prompt and forward shipment, can only be described as moderate. The Cie Generale Transatlantique is reported to have purchased at least part of its requirements of Welsh large coal over next year at the present minimum prices, while the Andalucian Railways of Spain have placed an order for 11,000 tons of large coal for delivery during the next two months at various Spanish ports. Possibly there will be more activity in coal shipments immediately following the holidays than is the case at present, as chartering lately has displayed a little more liveliness.

Coalfield Items.

It is reported in coal circles here that negotiations which have been in progress for the acquisiton of the Beddoe Rees and Henderson groups of anthracite collieries in South Wales by the Amalgamated Anthracite Collieries, Ltd., at the head of which is Lord Melchett, have now reached a satisfactory conclusion, which, upon ratification, will mean that the Amalgamated undertaking will control just over 80 per cent. of the anthracite production in this district, which amounts to about 5,000,000 tons per annum. Notices which were recently served upon the miners at North's Navigation collieries in the Maesteg district took effect on Saturday of last week, and about 2000 men are idle, but it is understood that negotiations are proceeding between the company and the workmen for a revision of the existing price lists and day wage rates. If these discussions turn out successfully, and the rates are brought into line with those in operation at neighbourhing pits, then the collieries will be reopened. A portion of Messrs. Vipond's Varteg Colliery, near Pontypool, which was shut down recently, was reopened for work on Monday, and a fair number of the 1100 men who had been rendered idle were re-employed.

Holidays.

The holidays in the South Wales coalfield will be Monday, Tuesday and Wednesday, work being resumed on the Wednesday night shift. At the docks there will be no work on the part of the coal trimmers and tippers on Monday and Tuesday, while on Wednesday two short shifts will be worked, from 8 a.m. to 12 noon and from 12 noon to 4 p.m.

Coal Contract.

The Sudan Government has contracted for 50,000 tons of coal, consisting of two-thirds large and one-third small for delivery over seven months commencing September, half of the above quantity to be drawn from South Wales and the other half from Natal.

Traffic Returns.

The Great Western Railway Company's returns of trade at the local ports under its control show that for the four weeks ended July 8th last imports and exports came to the total of 2,826,349 tons, which compared with 2,965,381 tons for the corresponding period of last year. Taking the whole of this year to July 8th last the aggregate of imports and exports came to 18,263,143 tons, which compares with 20,519,542 tons for the same period of last year, and with 19,473,896 tons for the same period of 1925. Up to July 8th last coal and coke shipments amounted to 13,851,818 tons, as against 15,243,648 tons last year.

Current Business.

The tone of the steam coal market remains extremely quiet, and provides no feature of interest. All qualities of large coal continue to be freely obtainable at minimum prices, and even small coals, with the exception of a few grades, can be secured without difficulty. The need of collieries in most cases has been for prompt orders to enable them to effect the quick clearance of wagons. The patent fuel and coke markets remain quiet, and owing to the difficulty of getting wagons, pitwood has lost some of its steadiness.

CONTRACTS.

CAMMELL LAIRD AND CO., Ltd., of Birkenhead, have received an order from Messrs. Elders and Fyffes, London, for two large passenger and fruit-carrying steamers for service between the West Indies, Central America, and this country.

CROMPTON PARKINSON, Ltd., has received from the Bermondsey Borough Council an order for a direct-current switchboard, the function of which will be to control 10,000 kilowatts of 500-volt rotary converter plant for lighting and traction, and there will be provision for 2000 kilowatts of extensions. This board will be one of the largest, if, indeed, not actually the largest, to be installed in this country in recent years.

RANSOMES AND RAPIER, Ltd., of Ipswich, have recently received orders for (*a*) four 75-ton steam breakdown cranes for the Bengal-Nagpur Railway, India; these are to be of the "Stokes" relieving bogie type; (*b*) one 40-ton "Stokes" type breakdown crane, for the Sorocabana Railway, Brazil; (*c*) one 80-ton breakdown crane, for the South Manchurian Railway, Manchuria; and (*d*) one 35-ton breakdown crane, from the Indian Office for the Great Indian Peninsula Railway. The total value of these contracts amounts to approximately £45,000.

THE GREAT WESTERN RAILWAY COMPANY officially announces that the following contracts have been placed:—(*a*) Supply of one omnibus body for a thirty to thirty-five-seater chassis, John Buckingham, Ltd., Bradford-street, Birmingham; (*b*) supply of seven 3-ton chassis and thirty-one 30-cwt. chassis, J. I. Thornycroft and Co., Ltd., Thornycroft House, Smith-square, Westminster; (*c*) supply of one six-wheel 2-ton Morris chassis, Morris Commercial Cars, Ltd., Foundry-lane, Soho, Birmingham; (*d*) extension of goods offices, &c., at Slough, Messrs. H. D. Bowyer, 29, Mackenzie-street, Slough; (*e*) provision of four spare lifting rams for Tannett-Walker coal hoists at Swansea, The East Ferry Road Engineering Works Company, Ltd., Millwall, E.; (*f*) supply, delivery, jointing, and connecting up of high-tension electric cables and supervision of cable laying at Swindon Works, Siemens Bros., Ltd., Telegraph Works, Woolwich, S.E. 18; (*g*) supply, delivery and erection of one 2-ton electric transporter crane at Brentford Dock, S. H. Heywood and Co., Ltd., Reddish; (*h*) supply of sixteen air-cooled engines in connection with the conversion of electric trucks to petrol-electric drive at Swindon Works, The Coventry Victor Motor Company, Coventry; and (*i*) the provision of a new store at Caerphilly locomotive depôt, Messrs. E. C. Jordan and Son, Newport.

CITY AND GUILDS OF LONDON INSTITUTE, FELLOWSHIPS.—The Council of the City and Guilds of London Institute has conferred the distinction of Fellow of the Institute (F.C.G.I.) upon the following:—Mr. A. B. Buckley, M. Inst. C.E., Mr. A. C. Cookson, M. Inst. C.E., Mr. C. V. Drysdale, M. Inst. C.E., Mr. M. Solomon, M.I.E.E., and Mr. G. W. Tripp, Assoc. M. Inst. C.E., M.I.M.E. The Fellowship is conferred by the Council upon those who, having obtained the Associateship of the Institute and spent at least five years in actual practice, produce evidence of having done some original and valuable research work or of having otherwise contributed to the advancement of the industry in which they are engaged.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	10/- to 21/-
(1) Spanish	19/- to 21/-
(1) N. African	19/- to 21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 11 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 8 0	3 8 0
No. 1	3 8 6	3 8 6
Cleveland—		
No. 1	3 8 6	3 8 6
Silicious Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 2 6	—
(3) Northampton—		
Foundry No. 3	2 15 0 to 2 17 0	—
Forge	2 13 6	—
(3) Derbyshire—		
No. 3 Foundry	3 0 0 to 3 1 0	—
Forge	2 18 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 1 0	—
No. 4 Forge	2 18 6	—
Basic	3 0 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 1 0 (a) / 4 4 0 (b) / 4 7 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
Midlands—		
Crown Bars	9 5 0 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 17 6 to 9 0 0	—
Gas Tube Strip	10 15 0 to 10 17 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ½in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 12 6	8 10 0
Sheets (Gal.Cor. 24 B.G.)	13 7 6 to 13 12 6	13 7 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 12 6	—
Soft Billets	6 15 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	7 10 0 to 10 0 0	—
Manchester—		
Bars (Round)	8 17 6	—
,, (Small Round)	7 15 0	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6	—
,, (Lancs. Boiler)	9 10 0 to 9 15 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 2 6 to 7 12 6	—
Intermediate Basic	7 0 0	—
Soft Basic	6 5 0 to 6 7 6	—
Hoops	9 0 0	—
Soft Wire Rods	7 5 0 to 7 10 0	—
Midlands—		
Small Rolled Bars	7 17 6 to 8 0 0	—
Billets and Sheet Bars	6 1 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 7 6 to 13 10 0	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/3
Block Tin (cash)	214 0 0
,, (three months)	213 5 0
Copper (cash)	62 13 9
,, (three months)	63 2 6
Spanish Lead (cash)	20 18 9
,, (three months)	21 2 6
Spelter (cash)	25 0 0
,, (three months)	24 17 6
Manchester—	
Copper, Best Selected Ingots	67 0 0
,, Electrolytic	69 10 0
,, Strong Sheets	94 0 0
,, Tubes (Basis Price). lb.	0 1 1½
Brass Tubes (Basis Price), lb.	0 1 0
,, Condenser, lb.	0 1 2
Lead, English	22 10 0
,, Foreign	21 10 0
Spelter	25 2 6
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/7 per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 0 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£20 10 0	7/-
,, ,, 8 p.c. to 10 p.c. ,,	£20 0 0	6/-
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	12/-
,, ,, ,, 1 p.c. carbon	£39 0 0	15/-
,, ,, ,, 0·70 p.c. carbon	£44 0 0	17/-
,, ,, ,, carbon free	1/2 per lb.	
Metallic Chromium	2/8 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 5 0 scale 5/- per unit	
,, ,, 75 p.c.	£19 0 0 scale 6/- per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	4/3 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/- per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	14/3 to 14/6
,, ,, Splint	16/- to 17/-
,, ,, Trebles	13/-
,, ,, Doubles	12/6 to 12/9
,, ,, Singles	12/-
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	15/6
,, ,, Trebles	13/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	10/9 to 12/9
Screened Navigation	18/-
Trebles	12/9 to 13/-
Doubles	12/6 to 12/9
Singles	11/6
Lothians—	
(f.o.b. Leith)—Best Steam	12/-
Secondary Steam	11/6
Trebles	12/6 to 13/-
Doubles	12/6
Singles	11/6 to 12/-

ENGLAND.

	Inland.
(8) N.W. Coast—	
Steams	24/- to 25/-
Household	37/6 to 50/-
Coke	22/6 to 23/6
Northumberland—	
Best Steams	13/3 to 13/6
Second Steams	11/9 to 12/-
Steam Smalls	9/- to 9/6
Unscreened	11/9 to 12/-
Household	21/- to 27/-
Durham—	
Best Gas	15/-
Second	13/3 to 13/9
Household	21/- to 27/-
Foundry Coke	18/3 to 19/-
Sheffield—	
Best Hand-picked Branch	26/- to 27/6 —
Derbyshire Best Bright House	19/6 to 20/6 —
Best House Coal	18/6 to 20/- —
Screened House Coal	16/- to 17/- —
,, ,, Nuts	14/- to 15/6 —
Yorkshire Hards	14/- to 16/- —
Derbyshire Hards	14/- to 16/- —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	5/- to 6/- —
Smalls	3/- to 4/6 —
Blast-furnace Coke (Inland)	13/- at ovens —
Furnace and Foundry Coke (Export), f.o.b.	18/- to 19/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	18/- to 19/-
Best Dry Large	18/- to 18/6
Ordinary Dry Large	17/3 to 17/9
Best Black Vein Large	17/6 to 17/9
Western Valley Large	17/- to 17/3
Best Eastern Valley Large	16/6 to 17/3
Ordinary Eastern Valley Large	16/3 to 16/6
Best Steam Smalls	12/6 to 12/9
Ordinary Smalls	10/6 to 12/-
Washed Nuts	16/6 to 18/-
No. 3 Rhondda Large	19/6 to 20/-
,, ,, Smalls	14/- to 14/6
No. 2 ,, Large	16/- to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	12/- to 13/-
Foundry Coke (export)	27/- to 36/-
Furnace Coke (export)	20/- to 20/6
Patent Fuel	21/- to 22/-
Pitwood (ex ship)	27/6 to 28/-
Swansea—	
Anthracite Coals:	
Best Big Vein Large	34/- to 35/-
Seconds	24/6 to 27/-
Red Vein	20/6 to 27/-
Machine-made Cobbles	40/- to 43/-
Nuts	35/- to 43/-
Beans	23/6 to 26/-
Peas	18/- to 19/-
Breaker Duff	8/- to 8/3
Rubbly Culm	12/- to 12/6
Steam Coals:	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	10/- to 12/6
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.
(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Trans-Saharan Railway.

THE law creating a commission to investigate the possibility of constructing a railway across the Sahara Desert has now been promulgated. The task of the commission is to report upon (1) the technical aspect of the proposed railway, that is to say, whether it is practically possible and, if so, to decide upon the route to be taken, the carrying capacity, the system of traction to be employed, water supply and protection of the line; (2) the economical importance of the railway and its effect upon the development of the Colonies to the south of the desert; and (3) the commercial results that may be obtained and the financial measures necessary for the construction and working of the railway. The investigation should be completed within eighteen months from the time the commission is formed. While the Government has been obliged to institute this inquiry as the result of the persistent agitation of colonial interests, which are backed up by public opinion, there is a good deal of doubt as to whether the line can be a sound commercial and financial undertaking, and the object of forming the commission is to settle once and for all the question of whether the proposed railway across the desert is practically possible.

Artesian Wells.

There are five artesian wells in Paris—one at Grenelle, which was sunk in 1833 and has long since run dry; the well at Passy, which is now supplying only a very thin stream of water to the lakes in the Bois de Boulogne; the Buttes-aux-Cailles well, that started by giving 72 litres per second and is now delivering 18 litres to a swimming bath; and two others that were sunk by private owners for industrial purposes. In 1863 boring was carried to a depth of 718 m. in the Place Hébert, but before it could penetrate the clay to reach the water an accident occurred and a sum of two million francs was spent in a vain attempt to repair the damage. Nearly two years ago the Municipal Council started to bore another well in the rue Blomet with a view of supplying water to some new swimming baths. From all the wells the water has invariably a temperature of 26 deg. Cent. The experience of the Place Hébert well has always inspired caution, and now that the rue Blomet bore, with a diameter of 16in., has reached halfway through the 25 m. layer of clay at a depth of 506 m., the engineers are proceeding very carefully, and it is expected that the well will shortly be delivering 18 litres a second.

Reclaiming the Camargue.

For close upon a century various proposals have been made for reclaiming the quarter of a million acres of arid and saline territory in the Bouches-du-Rhône known as the Camargue, and the problem is now again under consideration by the Conseil Générale of the Department. The Camargue was obviously at one time under the sea. It produces salt and is the home of a particular breed of horses, but there is no other industry, although attempts at reclaiming the land have shown that it is possible to render it fertile. The problem lies in draining the salt lakes and marshes and irrigating the land with water from the Rhone, and it is proposed to do so by dredging the Vaccarès Lake so as to reduce its level and permit of all the salt water flowing into it. This water would be discharged into the Mediterranean by a powerful pumping plant to be erected at Mornès, the machines being actuated by electrical energy supplied by a hydro-electric station at Mayrargues, on the river Durance. After draining the Camargue the Rhone will provide ample supplies of water for irrigating the whole of the territory, which, it is believed, will become a valuable agricultural region. The estimated cost of the undertaking is necessarily heavy, and the Conseil Générale is therefore investigating the ways and means of preparing a more economical scheme.

Labour in the Saar.

The dispute between the colliers and the Mines Domaniales has now reached an acute phase, when it is feared that a strike may break out at any moment. The trouble began three months ago, when the ironworkers asked for an advance in wages, which was refused. Since then there has been a continued agitation which spread to the coal miners, who also insisted upon an advance. The Mines Domaniales have taken up a firm stand by declaring that the miners in the Saar work fewer hours and are paid more than those in the Ruhr. Moreover, the situation of the coal trade is so unsatisfactory that it is quite impossible to impose upon it further charges which might increase the cost of coal. So long as the French work the Saar collieries they want to sell as much coal as possible in foreign markets, and they declare that an increase of wages would necessarily involve a restricted output and consequently the discharge of a considerable number of hands.

Foreign Trade.

The returns of foreign trade during the first six months of the year again accentuate the tendency towards a contraction of values, from which it is clear that producers have to make increasing sacrifices in order to secure business in international markets. The imports were valued at 26,327 million francs, a decline of 737 million francs as compared with the first half of 1927, and the exports totalled 25,249 million francs, a declension of 1591 million francs. As regards quantities the imports amounted to 23,899,878 tons, a decline of 2,103,930 tons as compared with the similar period of last year, and the exports totalled 20,184,972 tons, a contraction of 1,902,629 tons. It is noteworthy that while the imports of "material necessary for industry" declined by 1,131,758 tons, there was an increase in value of 231 million francs. Still more remarkable is that an increase of 1,638,470 tons in the exports of "material necessary for industry," including iron and steel, was accompanied by a fall in value of no less than 1942 million francs.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

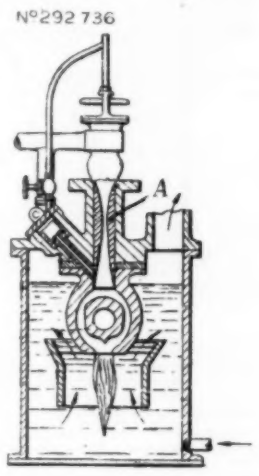
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

292,736. April 25th, 1927.—INTERNAL COMBUSTION BOILERS, O. Brunler, 31, Colville-terrace, London, W. 11.

The inventor points out that unless the conditions of supply of fuel and air to the burner and of steam pressure in the boiler are maintained constant, there is a tendency for the flame to recede into the burner. Then complete combustion cannot be

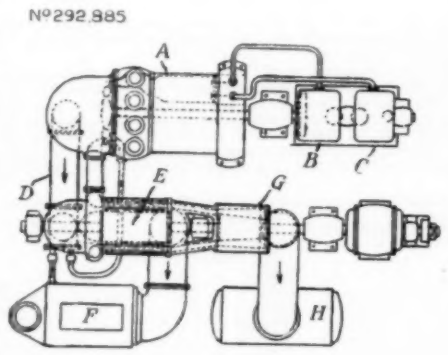


effected, and the efficiency falls. He consequently arranges a convergent-divergent nozzle A in the upper part of the burner and makes the passage through it so small that the speed of the combustible mixture is greater than that of the propagation of flame. The nozzle can be changed to suit different working conditions.—*June 28th*, 1928.

TURBINE MACHINERY.

292,885. June 23rd, 1927.—A COMPOUND EXPLOSION AND STEAM TURBINE PLANT, The Holzwarth Gas Turbine Company of America, 504, Standard Oil Building, 225, Bush-street, San Francisco, California, and H. Holzwarth, Engelbertus-strasse 110, Mulheim-Ruhr, Germany.

The internal combustion turbine is shown at A and drives the air compressor B and the gas compressor C. The exhaust from this turbine passes by the pipe D to the intermediate

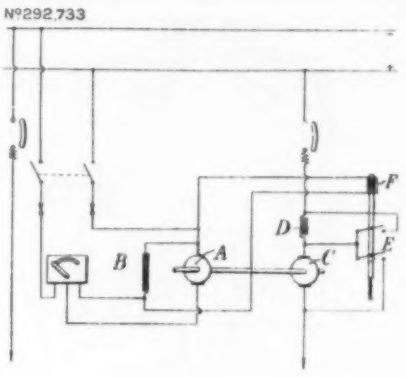


turbine E, and thence to the boiler F. The steam raised in the boiler is superheated in the exhaust pipe D, and is supplied to the runner of the turbine A for cooling purposes. The exhaust steam from this service is caught separately from the exhaust gases, and is led to the intermediate turbine, where it serves the same purpose again. The exhaust steam is again caught separately, is used in the low-pressure turbine G, and is finally condensed at H. The intermediate and low-pressure turbines drive the generator.—*June 28th*, 1928.

DYNAMOS AND MOTORS.

292,733. April 22nd, 1927.—PROTECTION DEVICES FOR MOTOR GENERATOR SETS, The English Electric Company, Ltd., R. A. R. Bolton, and F. G. Ford, 28, Kingsway, London, W.C. 2.

This invention relates to motor generator sets such as direct-current boosters of the kind in which one of the elements has its armature inserted in series in the line of the direct-current system to which it acts as a direct-current booster and the conditions in which determine the direction of flow of current through this armature. In such cases there is a danger that serious results may follow if the power supply to which the other element of the set is connected or the circuit of this element should fail. The actual results under these circumstances depend mainly upon the nature of the excitation of the field of the first-mentioned machine. Where this field is wholly or partly excited by a winding in series with its armature, the machine, when uncontrolled by the other machine of the set, will act as a motor having a predominantly series characteristic and being practically unloaded may reach a dangerous speed. For the purpose of dealing with this situation, it would be possible to introduce an automatic cut-out switch in the circuit of the booster in such a manner that this circuit was interrupted as a result of the failure or interruption of the supply of power to the motor. In cases, however, where continuity of supply was essential an arrangement of the above kind could not be employed, because on the operation of the cut-out switch the circuit supplied through the booster armature would be cut off from the source supplying current to the direct-current system. The present invention provides, for dealing with this situation, an automatic protective device of a

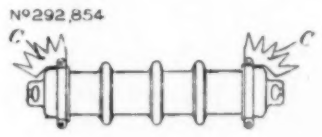


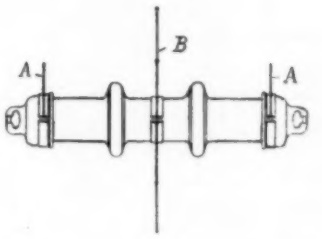
kind which does not necessitate the interruption of the booster circuit, and in accordance with it, a switch is arranged to short circuit the series boosting machine when the control of its speed by the other machine of the set fails. In the drawing A is the motor armature, B its shunt field, C the booster armature, and D its series field. The short-circuiting switch referred to is shown at E and is normally held open by the coil F, which is connected across the field of the motor.—*June 28th*, 1928.

ELECTRICAL APPLIANCES.

292,854. December 14th, 1927.—INSULATORS FOR HIGH-TENSION CONDUCTORS, F. Berg, 13, Kepplerstrasse, Mannheim, Germany.

The inventor states that short-circuits are frequently formed on high-tension transmission lines through birds perching on the insulators and touching the two caps simultaneously, or



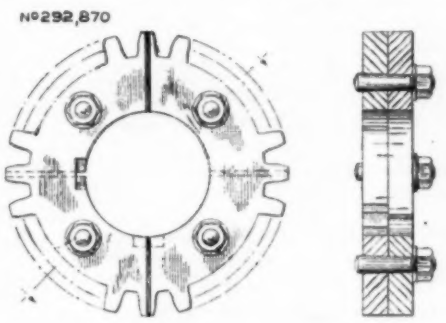


by two birds alighting together on the caps and touching one another. He consequently fixes metal points A A on the caps to prevent birds perching there, and another device B to keep them off the body of the insulator. In the place of the points A, serrated pieces of sheet metal C C may be used.—*June 28th*, 1928.

TRANSMISSION OF POWER.

292,870. January 19th, 1928.—MOUNTING GEAR WHEELS ON SHAFTING, H. S. Rowell, 15, Bolton-road, Chiswick, London, W. 4.

This is a split gear wheel for mounting on an existing shaft, and is built up of four semi-circular pieces with the diametral joints set at right angles. The pieces are bolted together, as shown, with bolts having inclined faces, so that the joints are



pulled tight together. It is claimed that the resultant of the pulls of the several bolts is in a radial direction. Two keys, at 90 deg., are used to fix the wheel on the shaft, and as each key passes only half-way through the wheel, it is secured in all directions. In a modification it is suggested that the two halves of the wheel may be kept in register by balls arranged in V-shaped grooves.—*June 28th*, 1928.

MEASURING AND TESTING INSTRUMENTS.

292,859. December 31st, 1927.—DIFFERENTIAL PRESSURE GAUGES, R. Bosselmann, Spenerstrasse 33, Berlin, N.W., Germany.

This differential pressure gauge is put forward as being capable of withstanding high pressures and yet giving accurate indications

of small variations in pressure. It comprises two chambers A and B, which are connected with the sources of pressure by the branches C and D. Within each chamber there is a piston E, and these two pistons are connected together by a link F. This

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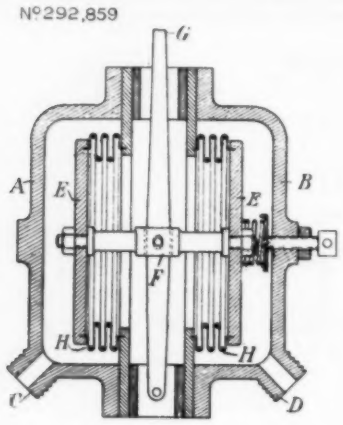

link serves to make a connection with the indicating mechanism by means of the lever G. The joint between each of the pistons and their containing chambers is made by means of the corrugated diaphragms H H, which are reinforced to withstand the external pressures as shown.—*June 28th*, 1928.

MACHINE TOOLS AND SHOP APPLIANCES.

292,866. January 12th, 1928.—FRICTION PRESSES, L. Witkowski, Märzstrasse 134, Vienna XIII., Austria.

The object of this invention is to minimise the one-sided thrust usually imparted to the friction disc of a screw press. The disc A on the screw is driven by means of two pairs of wheels B C and D E, of which B and D are keyed on to the shaft F, while

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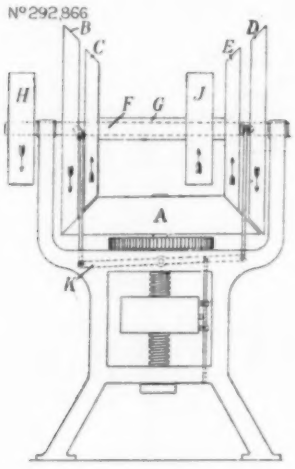

C and E are fixed on the sleeve G. The shaft and the sleeve are driven, through belting, by the pulleys H and J. In operation, the adjacent wheels are forced apart, as shown on the right, or closed together—see left—by the gear indicated at K, so that either one or the other of the two pairs of wheels operates on the disc simultaneously.—*June 28th*, 1928.

TRAMWAYS AND RAILWAYS.

292,732. April 21st, 1927.—WELDING TIE PLATES TO SLEEPERS, Siemens-Schuckertwerke Gesellschaft mit beschränkter Haftung, Berlin-Siemensstadt, Germany; L. Kuhl, 4, Dernburgstrasse, Berlin-Charlottenburg, Germany, and C. Ritz, 148, Berlinerstrasse, Berlin-Charlottenburg.

This machine is intended for simultaneously making the four

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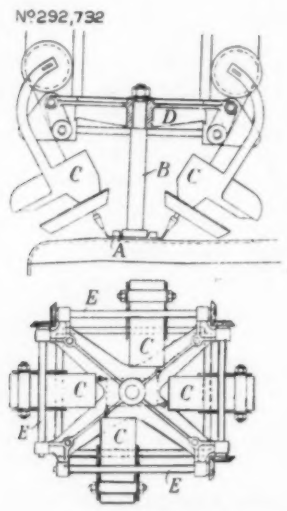

welds necessary for fixing a tie plate on to a steel sleeper, by the arc welding process. The tie plate is shown at A. It is held down in place by the ram B. There are four welding heads C C C C fixed in the frame D. The welding heads are travelled along the joints by the screws E E E E, which are geared together and driven by a motor. The sides of the tie plate have different lengths, so the feed screws are given different pitches to make all the operations take the same time, or switching arrangements are provided to cut off the welding current to the arcs at appropriate times.—*June 28th*, 1928.

MISCELLANEOUS.

285,826. August 24th, 1927.—IMPROVED ELECTRIC PLUG FUSE, Carl Greter, of 13, Hähnelstrasse, Berlin-Friedenow, Germany.

The fuse A is embedded in a non-combustible covering, such as glass or other transparent material. The upper part of the

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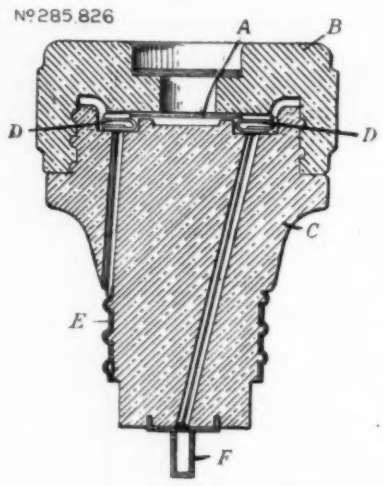

plug B screws on to the lower part C and the bare ends of the fuse make electrical contact with the flexible contacts D, which are connected to the screw thread E and plug F. The object of the invention is to provide a plug fuse that eliminates the risk of fire and which is cheap to construct.—*June 21st*, 1928.

292,878. February 10th, 1928.—CRANK SHAFTS, J. L. Macpherson, 112, Beachwood-drive, Broomhall, Glasgow.

In this built-up crank the pin A is forced into a hole in the web, or is shrunk in and is held against rotary movement by the

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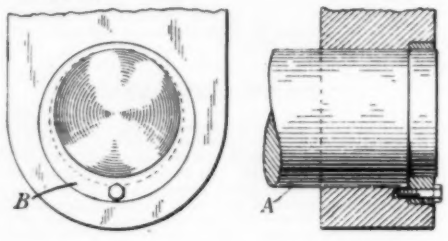

excentric ring B. It will be noticed that the ring is excentric to both the pin and the hole, and to different degrees. The ring is fixed by a stud.—*June 28th*, 1928.

292,882. February 20th, 1928.—HYDRAULIC APPARATUS, G. Tonks, 85, Great Hampton-street, Birmingham.

The aim of this invention is to hasten the early part of the working stroke of a hydraulic press. This is effected by admitting water from an overhead tank, and it is claimed that this water "augments the pressure generated by the pump"; but it would seem that the increase is in the volume of the flow rather than

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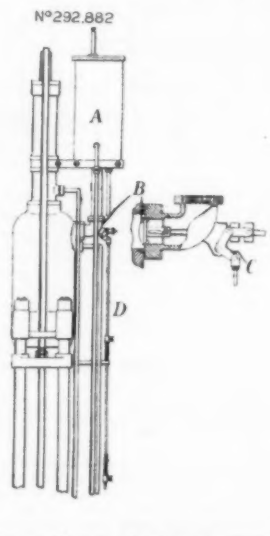

in the pressure. The auxiliary supply of water comes from the overhead tank A, and is admitted to the ram cylinder by the valve B. This valve is operated by the bell crank C, and tappet rod D, so that when the press platen is at the top of its stroke the valve is open to admit water from the tank. Near the bottom of the stroke the valve is closed again by the tappet rod.—*June 28th*, 1928.

293,286. March 14th, 1928.—ROTARY TRUCK TIPPLERS, W. H. Barker, Etna Works, Fenton, Stoke-on-Trent.

In this tippler the truck is clamped down to the rails by the hinged hook-shaped pieces A A engaging the axles. These hooks are fixed on the slide B and tend to engage the axles under the influence of the spring C. The truck is prevented from moving forward by one of the axles abutting against the stop D. In the loading position the hooks are held back by the rod E bearing against the fixed abutment F and the truck can be pushed

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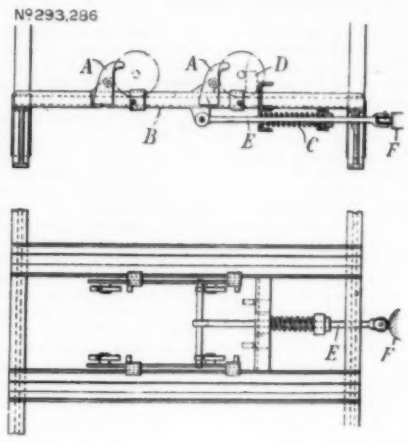

into place while the hooks rock on their pivots. As soon as the tippler starts to turn, however, the hooks are released from the abutment F and the spring C engages them with the axles.—*July 5th*, 1928.

293,271. January 10th, 1928.—TRANSPORTING PULVERISED COAL, H. A. Procter, 20, Draycot-road, Wanstead, London, E. 11.

It would appear that the inventor contemplates the supply and delivery of powdered coal to various consumers in weighed quantities. The tank shown in the drawing is supported on a weighbridge and is filled from a hopper through the flexible connection A and valve B. Within the tank there is a partition C,

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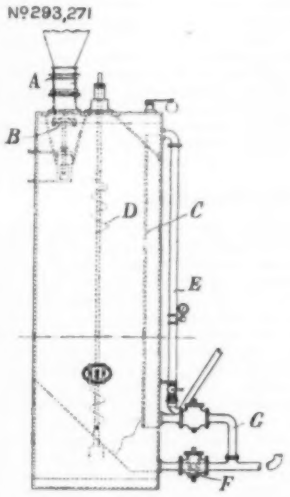

while a screw D serves to agitate the coal. The pipe E serves to supply compressed air from a flexible connection. The outlet valve for the powder is shown at F. When the tank is filled with powdered coal air is admitted at a pressure of 75 lb. per square inch. The weight of the coal and the air pressure force it out through the valve F and some air escaping down the inside of the partition C keeps it in motion. The branch G is used to blow the pipe connections clear of coal.—*July 5th*, 1928.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE WESTERN SOCIETY OF ENGINEERS asks us to announce that it has changed its address from 53, West Jackson Blvd., Room 1735, Monadnock Block, to 205, West Wacker Drive, Room 1200, the Engineering Building, Chicago, Ill., U.S.A.

AUTOMATIC AND ELECTRIC FURNACES, Ltd., of Elecfurn Works, North-road, Holloway, London, N. 7, asks us to announce that an arrangement has been entered into between it and Vickers-Armstrongs, Ltd., Broadway House, Westminster, S.W. 1, whereby it will demonstrate and sell the Vickers-Armstrong hardness testing machine.

BUSK STUDENTSHIP IN AERONAUTICS.—The Trustees of the Busk Studentship in Aeronautics, which was founded in memory of Edward Teshmaker Busk, who lost his life in 1914 whilst flying an experimental aeroplane, have awarded the studentship for the year 1928–9 to Mr. John Joseph Green, B.Sc., of the Royal College of Science, London.

CLEANING OIL COOLERS.—The removal of the asphaltic deposit which settles upon the surfaces of oil coolers and lowers their efficiency is a troublesome matter. We are informed by the research department of Alexander Duckham and Co., Ltd., that a safe and effective solvent has now been found. The treatment is carried out by uncoupling the oil and discharge pipes, introducing the asphalt solvent, injecting steam, and finally flushing with soda and with hot water.

GOODWILL IN INDUSTRY.—Mr. J. G. Pearce, director of the British Cast Iron Research Association, has been unanimously awarded by the judges the first prize of 100 guineas for a series of practicable proposals relating to "Goodwill in Industry." The competition was organised by the Glasgow and West of Scotland Association of Foremen, Engineers and Draughtsmen, and the judges represented the three parties in industry—the employer, the worker, and the technical or administrative officer—being Sir Archibald Denny, chairman of the British Engineering Standards Association; Mr. J. T. Brownlie, President of the Amalgamated Engineering Union; and Mr. John Holloway.